THE

ELECTRICAL REVIEW.

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THE POSTAL TELEGRAPHISTS.

THE decision of the Postmaster-General in the matter of the recent inquiry into the case of the Postal Telegraphists will, of course, be received with profound dissatisfaction by the members of the staff. These plan out for themselves a nice little scheme by which they are to largely benefit, and which, unless agreed to by the authorities, is to result in a general strike. The answer of the Postmaster-General is practically a refusal to concede the most important demand, viz., that the maximum of salary shall be £190 instead of £160 per annum. In our opinion the action of the telegraphists in the matter, quite irrespective of the justice or injustice of their claims, has been a great tactical mistake. They have claimed two things: the abolition of a technical examination, and the increase of the maximum salary from £160 to £190. We are not in a position to say what the exact nature of the technical examination is—whether it is a difficult or an easy one—still less are we able to say whether, since the establishment of this examination in 1894, the number of the staff who have failed to pass has been large or small. We believe that nothing was said on this point in the evidence before the Committee of Inquiry. Perhaps those who gave evidence were discreetly silent on this point. Whatever may be the case, however, as regards this, we should have thought that common sense would have told the agitators that their policy should have been to ground their claims, not on the unimportance of their duties, but on their high technical nature, as evidenced by the technical examinations which they have to undergo. We feel satisfied that the authorities would not impose tests which men of ordinary intelligence could not readily pass if they had any real interest in their work; the agitators, however, practically demand to be considered as mere machines, but want to be paid as if they were something greatly superior. Can it be honestly said that the manipulative skill of an average telegraphist is greatly in excess of that of a skilled typewriter, and what is the maximum of pay attainable by the latter. Indeed, is the skill nearly as great as that of a first-class mechanic, who has in the first place to undergo an apprenticeship of seven years, and who has no chance of ever obtaining as a workman the pay which the agitators demand. Again, from a commercial point of view, does a telegraphist become more and more valuable as he gets older, and obtains more pay? We doubt it.

The reply of the Postmaster-General appears to amount to this: "You consider the technical examinations unnecessary, *i.e.*, that manipulative skill is all that is required; ver well then, as you have shown your importance to be much less than was imagined, it would be absurd to suppose that you should be paid high salaries for inferior duties."

We shall watch with interest the further development of the matter. If a general, or even a partial, strike is decided upon—which is not unlikely—we do not believe that the general public will be found much in sympathy with the strikers. However great the inconvenience caused by a

partial cessation of telegraphic communication, it is not to be supposed for one moment that the authorities will alter their policy from any fear of the consequences. The Postmaster-General concludes his decisions with the statement that no branch of the Public Service ever received ampler opportunities for stating and re-stating their case than have been accorded to the staff of the Post Office. This, we think, must freely be admitted.

No Need to Go Abroad.

One of the daily newspapers is our authority for the statement that Sir A. B. Forwood has resigned the chairmanship of the Liverpool City Council Tramways Committee because of an adverse vote in regard to the Committee's proposal to engage an American engineer for carrying out and supervising the work on the experimental trolley line section to be shortly equipped. If this be the case, we think that the Liverpool City Council has shown a good deal of common sense and fairness. No reasonable Englishman wishes for the days of Protection to return, and we are as strong Free Traders as any one could wish to be; but when there are engineers in this country of professional standing, such as Prof. Kennedy, or Dr. Hopkinson, and manufacturers of world-wide repute, we don't need to go across the Atlantic for a consulting engineer who shall be capable of carrying out a complete electric tramway system. There are many directions, as, for instance, the design and manufacture of tramcar motors and controllers, in which we acknowledge American supremacy, and in these we are glad to avail ourselves of Brother Jonathan's experience (of course paying for it), but to call in a consultant from the other side is rather too much of a good thing. The Dingley tariff is hardly likely to encourage the average Englishman to shower benefits unnecessarily upon America. Of course, we have not a word to say against the elect of Liverpool's Tramway Committee; far from that, for Mr. Pearson (we understand it is he) must have by now acquired such a mass of traction experience as few others possess. Yet it must be remembered that his skill and knowledge deal with conditions as they are found across the Atlantic, and these are not by any means necessarily the same as rule at Liverpool or elsewhere in this country. Apart from that, however, we protest against the Committee asking for powers to engage Mr. Pearson as an expert, if only on the ground that there are competent Englishmen ready to undertake the work, and in overruling this proposal of the Committee, the City Council is to be congratulated. We are surprised that the Chairman of the Committee should have taken such a course as that of resignation; a step of this kind savours too much of pique, which ought hardly to enter into an important municipal question. In any case it should not be regarded as a marked want of confidence for the Council to reject a part of the Committee's proposal, especially when patriotism is the cause. For the Council to give way now would put it in the position of yielding against its better judgment, in order to avoid unpleasantness.

The Growth of our Knowledge of Helium.

There is no necessity now to refer to the sensational conditions under which the discovery of argon took place. We had our say on the subject at the time, and it will be remembered that it was the manner or method in which the discovery was announced which chiefly called forth our criticism. We left the truth, or the untruth an open question, merely suggesting that the manner in which the announcement was made was premature, and scarcely warranted by the facts on hand. Lord Rayleigh and Prof. Ramsay doubtless had more reason than was in the first instance apparent for fathering this discovery, but they will probably have admitted long ago that the precedent, which they, as distinguished scientists have set is a bad one, and calculated to encourage mere guess work in a way that is not consistent with the true standpoint of science. The luck, however, has all been on their side, and probably they themselves will be the first to admit that fortune has favoured them. They had discovered a gas, which, though it had existed since the beginning of things, had hitherto been unsuspected. The knowledge of this gas, which we have now, owing to the researches of scientists other than Prof. Ramsay and Lord Rayleigh, acquired, is, as we will willingly admit, very considerable, though this knowledge is far from being accurate, and is still wrapped in some obscurity. The general propositions which we studied when the discovery was first announced, may still be found to hold. At any rate, we are not disposed to recede one step from the position which we took up at the time, and we flatter ourselves that those scientists who supported our views then still support them. Science has to deal with hard facts, the dramatic element must ever be absent; guess work must always be eliminated, and nothing is so prejudicial to the advancement of knowledge as prematureness. We are, however, of course, disposed to give honour where honour is due, and it is necessary to reiterate our conviction perhaps that all credit is due to Prof. Ramsay and Lord Rayleigh for the pluck and persistence with which they followed up a mere evanescent clue, and tracked the subject down until they were able to state something which was definite. Our own attitude towards this discovery may be disregarded. As luck would have it, the premises upon which it was based, though right in principle, have fought on the other side. To-day argon is known to exist; to-day helium has been discovered in terrestrial substances, and our knowledge of the hidden mysteries of nature has been enriched. When the sensational announcement of the discovery of argon was first made, we wondered why such experts in spectroscopy as J. Norman Lockyer had so little to say upon the subject. It seemed to us to be one that was eminently suited to such an investigator. Recent publications have shown that this expert, together with others, have not been indifferent to the matter which is peculiarly one of their own. One of the most enlightening papers upon this subject has recently appeared over the signature of J. Norman Lockyer in *Science Progress*, Vol. v., No. 28, pp. 229 to 285. In this paper the judicial attitude of a well-balanced mind is plainly evident. He traces the growth of our knowledge of the element helium from the discovery of the line D in 1868. The paper comes opportunely. Some there are who say that true history can only be written years after the events with which it deals have happened, but we are amongst those who are of opinion that an unbiassed statement of fact issued contemporaneously with any discovery is helpful and illuminating. Of such a nature is Lockyer's paper, and we commend it most earnestly to the careful study of all those who are endeavouring to unravel the hidden mysteries of argon and helium. Here we have a concise and unbiassed view of the history of the subject, and we are disposed to once more subscribe to that old adage which states that "there is nothing new under the sun." The paper in question is not suitable for useful abstraction or condensation in these pages. Every word of it is of value, and we commend it to those of our readers whose interest has been aroused on this subject.

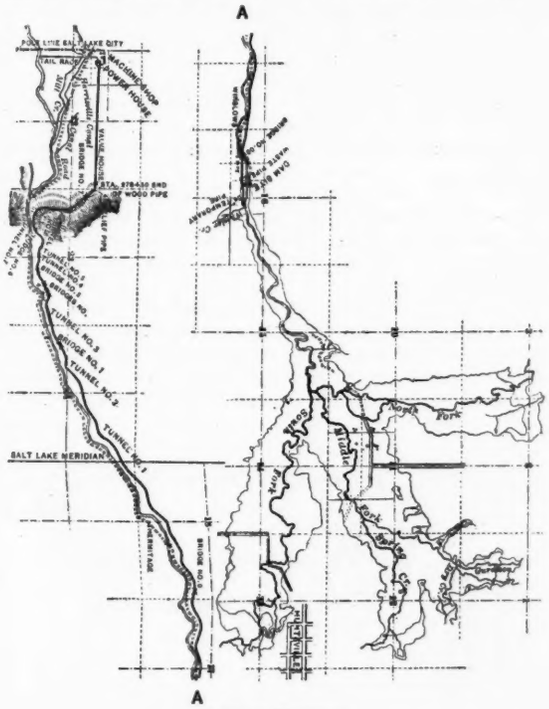
HYDRO-ELECTRIC POWER STATIONS IN THE UNITED STATES.

(*Continued from page* 172.)

There are, perhaps, but few of our readers conversant with any of the details of a 12,000 H.P. installation at Ogden, in the State of Utah, where the Ogden River is already dammed up in a temporary fashion, before passing through the five mile canon above Ogden City, and we therefore append a brief abstract (with one or two diagrams) of the description of these works published in the *Proceedings* of the American Society of Civil Engineers.

First of all, however, let it be said that this paper—written by Mr. Henry Goldmark, M.Am.Soc.C.E., the engineer in charge of the dam and pipe conduit construction—is a standing contradiction to the statement (sometimes made, we fear, with a substantial basis) that American engineers do everything in an off-hand slapdash rough and ready fashion. We seldom have read an account of any engineering enterprise that showed greater attention to every little detail down to the calculation of riveted steel plate joint efficiencies, or the spacing $\frac{1}{8}$th of an inch more or less apart of the round steel rods that hold the staves together in the wooden conduit 6 feet diameter.

The works involved in this project include the construction of a large storage reservoir with concrete masonry dam



Plan of District.

above the canon; a wooden pipe line 6 feet diameter down the canon for a distance of 5½ miles from the reservoir, steel pipe being used for the remaining three-fourths of a mile in view of the heavy pressure from that point; and, lastly, a power house containing the pressure turbines and electric generators.

The current thus generated is taken along an overhead transmission line from the power house to a sub-station in Salt Lake City, 38 miles away; at present, two three-phase circuits are in use, calculated to deliver about 3,000 H.P. Current is generated at 2,300 volts and 60 cycles, stepped-up for transmission to 16,100 volts, and re-transformed at the far end to 2,300 volts. A slight change in the transformers would enable the current to be stepped-up to 27,000 volts, and thus increase the capacity; and this will be done should occasion demand it.

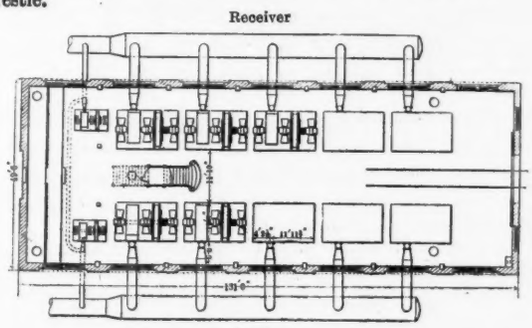
The details given in Mr. Goldmark's paper of these four sections into which the whole project may be divided (reservoir, pipe line, power house, and pole line, are extremely interesting, and contain a great deal of valuable information; but cannot, of course, be dealt with very fully in these pages. It must suffice to mention their leading characteristics, and comment favourably or otherwise on such as have points of great interest for engineers on this side.

The reservoir—which has yet to be formed in its ultimate extent—is to cover a space of about 2,000 acres, with a capacity of about 15,000,000 gallons. Thus it will cover, when completed, twice the area of Lake Vyrnwy, and have 25 per cent. greater capacity. The design of dam adopted is somewhat novel, and decidedly ingenious, consisting as it does of a concrete masonry viaduct of isolated piers joined by segmental arches. The general plan is clearly shown in the accompanying diagrams, in which may also be noted the ¼-inch steel plate covering on the up stream face, to prevent abrasion of the concrete, and consequent percolation of water. Of course, the outer surface of these plates are well coated with asphaltum paint.

A dam of this type must be very much cheaper to build than a structure of the solid masonry kind to which we are accustomed. There seems no great reason to doubt its strength or power of resistance; but certainly we should be surprised to find English engineers sufficiently progressive to propose an innovation of the kind.

The length of the dam is about 400 feet, its height above the present river bed about 60 feet, whilst the foundations extend another 40 feet to bed rock, making a total height of over 100 feet.

Leading from a gatehouse near the dam is the wooden pipe line 6 feet inside diameter, laid for the most part in a trench 8 feet 6 inches wide and 9 feet deep, and having a total length of 27,000 feet, in which distance there are eight tunnels cut out of the rock, eight steel bridges, and a timber trestle.



Plan of Power House.

The maximum hydrostatic head on the wooden pipe line is 117 feet, giving a pressure of 50 lbs. per square inch.

The wooden pipe line (of which very elaborate details are given in the paper, and which really seem most carefully planned in every particular), follows of course the general direction of river flow along the canon mountain side; but after emerging from the gulley it is replaced for the lower end of the conduit by built up steel piping in a straight line across country, but with a number of vertical curves for seven-eighths of a mile to a point near the power house, separating there into two branches that lead into two receivers on each side of the power house. The turbine pipe connections are made direct to the receivers.

The total hydrostatic head from the flow line of full reservoir to centre line of receivers is 516 feet; but taking the effective head at 440 feet, with a flow of 250 cubic feet per second, the gross available horse-power works out to about 12,500.

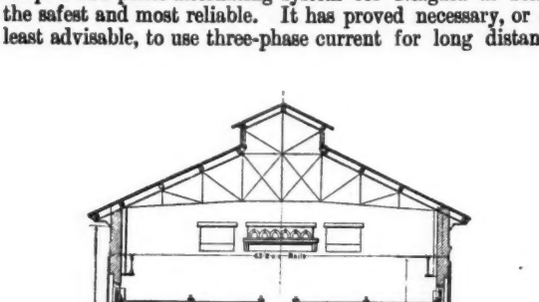
The turbines, as stated, are of the impulse type, with horizontal shafts directly connected to the electric generators; they have a diameter of 58 inches with a capacity of 1,200 H.P. each, running at 300 revolutions per minute. The dynamos are three phase alternators, giving an output of 750 kilowatts at 2,300 volts and a frequency of 60 cycles. Exciting current is obtained from two separate small machines of 100 kilowatt capacity each, at 500 volts and 550 revolutions, worked by two independent 135 H.P. turbine wheels (coupled direct) at 550 revolutions per minute.

After passing the wheels, the water leaves by a canal, partly covered and partly open, back to the river bed; but it may be mentioned, as a point of interest, that it is not allowed to "stay in bed" for long. Five miles lower down

the river is again drawn upon for irrigation purposes over some 18,000 acres of land, and the same water therefore serves a double purpose.

At the time of writing all the work is done and plant erected, save only the permanent dam and reservoir; but a temporary crib dam has been erected just above the site of the main structure, so that the necessary pipe pressure may be obtained, and current generated to an extent consistent with the limited storage.

It is interesting to compare the main features of the power house installation at Ogden with those so much described of late in connection with the Niagara power house. To begin with, the direct use of three-phase current generators marks no small degree of progress made since it was decided to adopt a two-phase alternating system for Niagara as being the safest and most reliable. It has proved necessary, or at least advisable, to use three-phase current for long distance



Sectional Elevation of Power House.

transmission from Niagara, so that the Ogden plant starts in at once with the advantage of having no rotary converters for long distance transmission currents.

Then the differences in the hydraulic arrangements at Ogden and Niagara are very considerable. Perhaps the type of water-motor employed is due to the greater hydrostatic head in the former case; but there are obvious advantages in the horizontal turbine shaft quite short in length, instead of long and heavy vertical spindles, with step bearings such as those used at Niagara. Each water-wheel at Ogden is provided with two heavy fly-wheels, and the moving parts of each set, including armature, water-wheel, shaft and fly-wheels have a total weight of 15 tons, so that it is not difficult to maintain a uniform speed despite variations in water pressure or load on the electric generators. The latter are of the General Electric type, with 24 poles, and, at 300 revolutions per minute, have, as stated, an output of 750 kw. at 2,300 volts, and a frequency of 60 cycles per second. According to factory tests, the variation in volts will be less than 5 per cent. with a constant speed, should the full non-inductive load be thrown off or on.

The exciters are six-pole machines. Each of them is ample for the entire exciting current that will be needed for the 10 750-kw. alternators. They are cross connected to each water receiver, so that either exciter set can be operated from either receiver.

The generator switchboard consists of seven marble panels; five of these are for the alternators, one for the exciter, and one the instrument panel.

Each generator panel has the following apparatus on it:—One 150-volt Thomson alternating voltmeter; one 1,000 kw. Thomson alternating wattmeter; one 25-ampere Weston ammeter; three single-pole quick break 200-ampere switches for the primary circuits; three single-pole 200-ampere high tension fuse boards; two single-pole quick break low tension 30-ampere switches; one field rheostat; two pilot lamps; one station transformer; three current transformers; two sets three-phase bus bars.

The exciter panel is equipped with the following apparatus:—Two 600-volt Weston voltmeters; two 300-ampere Weston ammeters; two pilot lamps; two single-pole quick break 200-ampere switches; four single-pole 200-ampere magnetic cut-outs; two field switches; two Carpenter enamel field rheostats. On the instrument panel are:—

Two pilot lamps; two 5,000-kw. Thomson alternating wattmeters; two 130-volt Bristol recording voltmeters; one Bristol recording water-pressure gauge; one synchroniser with two plug boards; one ground detector with two plug boards; two station transformers; eight current transformers.

These panels are 36 × 90 × 2 inches each. They are built of blue Vermont marble, with nickel fittings. There are two sets of three-phase bus bars on the back, extending the entire length of the seven panels, as well as two bus bars, also running their entire length, from which the exciting current is taken.

The speed indicating apparatus consists of a tachometer coupled to the shaft of a small synchronous motor; there are two of these.

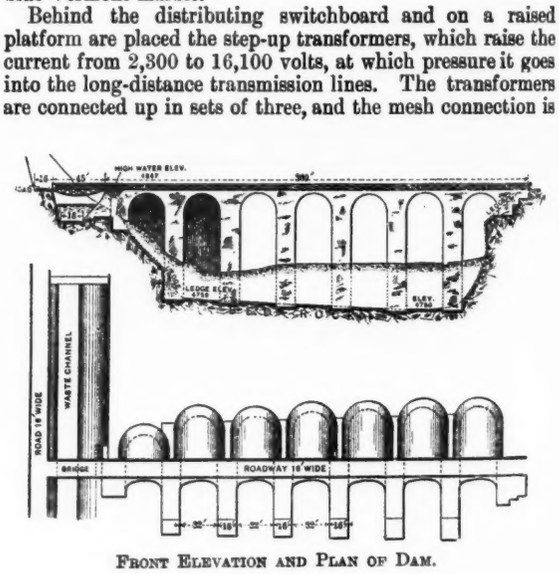
From the generator switchboard the current is carried to the distributing board by means of copper bars, of which there are two sets of three, connecting the two sets of bus bars on the generator board with the two sets of bus bars on the primary panels of the distributing board.

The latter is divided into two sections, primary and secondary. Each section has six panels. In the primary section, four of the panels are for the low side of the step-up transformers, the remaining two being for the local distributing lines in the vicinity of the power plant. In the secondary section, four of the panels are for the high side of the step-up transformers, and two for the long distance transmission lines.

The two 2,300-volt primary panels are each equipped with the following apparatus:—Three 350-ampere Thomson alternating ammeters; one Thomson recording wattmeter; three single-pole quick break high tension 200-ampere switches; three high tension 200-ampere fuse boards; three station transformers; two current transformers; two sets three-phase bus bars.

The 16,100-volt secondary panels have on them three single-pole quick-break switches, three plug tube cut-outs, and two sets of three-phase bus bars. The length of this distributing switchboard is 39 feet, and it is also built of blue Vermont marble.

Behind the distributing switchboard and on a raised platform are placed the step-up transformers, which raise the current from 2,300 to 16,100 volts, at which pressure it goes into the long-distance transmission lines. The transformers are connected up in sets of three, and the mesh connection is



Front Elevation and Plan of Dam.

used on both sides. At each end of the building in the gallery are placed two blowers, coupled direct to a 2½ H.P. 500-volt continuous current motor, and used for cooling the step-up transformers.

The transmission line is calculated to deliver about 3,000 H.P. at the sub-station in Salt Lake City, distant about 38 miles, and consists of two circuits, making six wires of No. 1, B. & S. gauge. Wooden poles are used of Oregon cedar, 30, 40, 50 and 70 feet long, with 9-inch and 10-inch tops. There are two cross arms on each pole, two wires are on the top arm 4 feet apart, and four wires on the bottom arm each 2 feet apart, a circuit being on each side of the pole; and these wires are so arranged that should a plane be placed perpendicular across the circuit it would show an

equilateral triangle, with a wire at each angle, the length of the sides being 2 feet. These wires are transposed about every half mile. By this arrangement of the pole line wires the inductive effect is reduced to a minimum.

About 6 feet below the second cross-arm on the pole is a two-pin cross-arm, on which the telephone wires are strung; these are transposed about every four poles, there being an average of about 50 poles per mile.

The current is delivered to the step-down transformers at the far end of line at 13,800 volts, stated to give an energy loss of about 10 per cent. in the line, and a potential loss of about 14 per cent. The sub-station step-down transformers deliver this current to the local distributing lines again at 2,300 volts. There are at present nine 250 kw. step-down transformers at the sub-station, connected in a way similar to the step-up transformers, and the switchboard in the sub-station is similar in every respect to the distributing board in the power plant gallery. The cooling apparatus here is also identical with that used in the power plant except that the motors used are of the 60-cycle induction type.

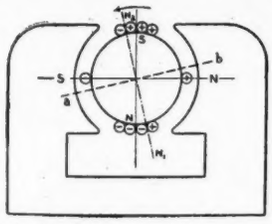
DYNAMO CHARACTERISTICS.*

By Prof. WILBUR M. STINE.

In order to intelligently study the characteristics of the dynamo, it will be necessary to consider the effect of armature reaction, and the causes for the departure of actual curves from their theoretical outlines.

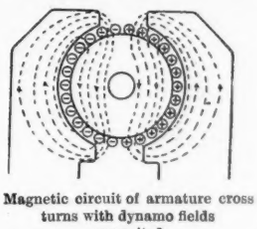
Armature Reactions.—With armatures of the closed coil type, the brushes bear on the commutator at the neutral points; these lie in the commutation plane which passes through the axis of the armature at right angles to the magnetic axis of the fields. In a perfectly symmetrical armature the current divides equally at the brushes and passes through the coils in series on each side. These coils being windings about an iron core, excite the core into an electro-magnet of considerable power. The lines of force thus set up in the armature by the current in its windings constitute a magnetic field whose direction is at right angles with the magnetic flux of the dynamo field. The result is a "skewing" of the dynamo field, and the brushes must be moved forwards to the now displaced neutral points.

This angular displacement of the brushes, which in the dynamo is in the direction of rotation, is called the angle of lead of the brushes. The predetermination of the angle of lead is rendered difficult by the unequal reluctances of the two magnetic fields. The relations of the angle of lead are shown in fig. 1; the neutral points are in the line, N_1-N_2,



Angle of lead due to armature cross turns.

Fig. 1.

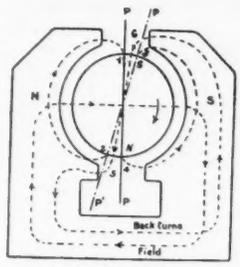


Magnetic circuit of armature cross turns with dynamo fields unexcited.

Fig. 2.

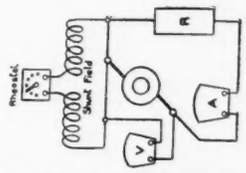
while the dotted line, *a b*, shows the direction of the dynamo field has been displaced forwards by an amount equal to the angle of lead. The deflecting ampere-turns due to current in the armature coils are known as "cross-turns." These have no direct influence in either weakening or strengthening the field. Owing to the forward displacement of the armature field, it is no longer symmetrically placed with reference to the pole-pieces. Its lack of symmetry varies with the amount of the angle of lead. The armature conductors on both sides lying within the angle of lead sustain a new relation to the dynamo field; they are not in position to "skew" the field, and are not to be considered as cross turns; their effect is to directly weaken or demagnetise the field, and from such are called "back turns."

A reference to figs. 2 and 3 may make the distinction clear. In fig. 3 the line, P P, is the theoretical neutral plane, while P′ P′ is the actual running plane of commutation for full load. The lines of force on the armature between the points 1 and 2 complete their external paths through the iron of the pole piece, N, while those between 3 and 4 pass



Showing back and cross turns.

Figs. 3.



Connections for determining external shunt curve.

Fig. 4.

through the pole piece, S. To these lines is due the angle of lead, and they are produced by the cross turns of the armature.

At the following pole tips they are in line with the dynamo field and strengthen it, while at the entering tips they are opposed to the field and weaken it by the same amount, and, as a rule, do not alter the E.M.F. generated by the conductors. But the lines from 5, due to the conductors between 2 and 4, and 1 and 3, selecting the paths of least reluctance, pass into pole piece, N, and around the frame, and coming out from the other pole piece, enter the armature again at (6). Upon tracing the direction of these lines, it is seen to be opposed to that of the field.

In effect, the field is demagnetised to the extent of the number of such lines. The path of these lines through the core and field has essentially the same reluctance as that of the field itself, and an ampere turn on the armature lying within the angle of lead will practically neutralise an ampere turn of the field winding. By calculating the back ampere turns the demagnetisation of the armature at full load may be compensated for by giving the series ampere turns an equal value.

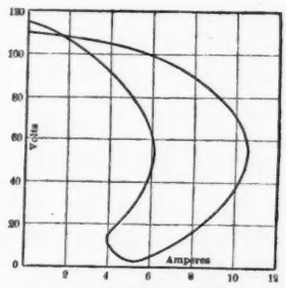
On the drum armature there are two conductors to a turn, and the current in any conductor is one-half the total armature output. If S be the number of conductors and I the total current, the ampere-turn due to this armature will be $\frac{I S}{4}$. The back turns are determined from the ratio of the angle of lead to 180°. Call the angle of lead a, then

$$\text{Back-turns} = \frac{I S}{4} \times \frac{a}{180^\circ}$$

An example of such calculations is the following: Number of armature conductors, 240; current at full load, 400 amperes; angle of lead, 15°.

$$\text{Armature ampere-turns} = \frac{400 \times 240}{4} = 24{,}000$$

$$\text{Back-turns} = 24{,}000 \times \frac{15}{180} = 2{,}000.$$



External shunt curve.

Fig. 5.

There are then out of a total of 24,000 armature ampere-turns, 22,000 cross-turns, and 2,000 back or demagnetising turns.

External Shunt Curve with Self-Excitation.—The data for this characteristic are given in Table, and the corresponding curve is illustrated in fig. 5. This particular curve was

* *American Electrician.*

obtained from the 4-kw. 110-volt dynamo already described. The connections are clearly indicated in fig. 4. During such a test the speed should be kept constant; the regulating rheostat, being set to give normal voltage on open circuit, should not be moved during the test. As the name of the curve suggests, the field is maintained by the shunt coils, the series winding being disconnected and the dynamo operated as a simple shunt machine.

External Shunt Curve.

Volts.	Amps.	Volts.	Amps.	Volts.	Amps.	Volts.	Amps.	Volts.	Amps.
110	0·	58	10·3	3·5	4·9	15	3·95	53	6·29
109	1·	39	10·1	4 5	4·69	16	4·05	56	5·8
108	1·48	32	9 6	5 5	4·49	17	4·1	65	5·2
107·5	1·95	30	9 4	6 5	4·38	18·25	4·29	69·5	5·5
106·5	2·88	25	8·9	6·7	4·29	20	4·38	75	5·3
104	2 57	22	8 58	7·75	4·2	21·25	4·4	80	5·38
99	5·9	20	8·49	9	4·15	23·5	4·7	85	4·15
95	6·91	18	8·2	9·75	4·	26	4·89	89	4·3
90	8 26	14·5	7·89	10 25	3 92	29·5	5·03	95	2·61
80	8·61	9	6·89	11·25	3·75	32	5·2	100	2·72
75	9·55	6	6·15	11·75	3 9	35·75	5·3	107	2·1
70	10·52	4	5·7	12·5	3·97	43	6·1	112	1·08
65	10 49	2	5·25	14	3·31	47	5·9	115	·05

In the scheme of connections, R is a variable resistance, in this case a rack of incandescent lamps; the resistance should have a carrying capacity equal to the normal output of the dynamo, and be capable of a wide range of adjustment, a range which may readily be determined by an inspection of the data in the preceding table. The curve illustrates both the peculiarities of the self-exciting shunt dynamo and the demagnetising effect of armature reaction.

It will be noticed that the curve slopes uniformly until an output of 10·5 amperes is reached. As this slope is a regular curve, and not a straight line, it shows that two variable causes are at work to decrease the E.M.F. of the dynamo. One of these is the demagnetising back turns; as the E.M.F. falls off from this cause, the current through the field weakens proportionally, and contributes its share to decrease the E.M.F. The current of 10·5 amperes may be termed the critical current for this dynamo, for if the external resistance be further decreased, the current *decreases*. The knee of the curve marks this critical point.

The resistance was decreased until the current reached 5·25 amperes with an E.M.F. of 2 volts. This bending backwards of the curve may be explained by excessive armature reaction, the field being weakened at a proportionally greater rate than the decrease of external resistance. The current of 5·25 amperes at 2 volts being obtained, the external resistance was gradually increased, with the result that the curve of ascending voltage closely resembled that of the descending. It is important to consider the effect of opening the external circuit at any of the lower E.M.F. values; suppose the circuit to be opened with 8 amperes at 17 volts, then the brush E.M.F. would at once go back to open circuit value, which would be nearly 110 volts, and it is obvious that if the circuit were then closed through this resistance of 2·1 ohms, a current of over 50 amperes would result, endangering the ammeter in circuit. For such reasons, those essaying the test should make it a continuous one, and avoid opening the circuit at any point.

An important conclusion may be derived from this curve. The fact that the critical point was reached at a current output less than one-third the normal capacity of the dynamo, indicates both a weak field and excessive armature reaction.

THE INFLUENCE OF HEAT TREATMENT UPON THE MAGNETIC PROPERTIES OF STEEL AND IRON.

Steel and iron, when heated to high temperatures, show a decided change in their magnetic properties. The earlier investigations have shown (Wiedemann's "Electricitaet," 2nd. ed., III., p. 848-860) that in general the temporary induction in iron and steel rods increases with increase of temperature. G. Wiedemann (*Pogg. Ann.*, 122, 346, 1864), found that very hard steel rods show at 100° a larger temporary magnetic moment than at 0°, soft rods a larger magnetic moment at 0° than at 100° for the same magnetising force, after they had been repeatedly heated and cooled. Rowland (*Phil. Mag.*, (4) 48, 321, 1874) showed that a rise of temperature causes an increase of induction if the magnetising force is small, but a diminution of induction if the magnetising force is large. The same was observed by J. Hopkinson (*Phil. Trans.*, 180 A, 442, 1889; *Proc.* Roy. Soc., 48, 442, 1890) who undertook a great number of experiments in this line, especially in order to show the relation between the critical temperature at which iron ceases to be magnetic, and the recalescence first discovered by Barrett. According to the former, recalescence occurs at the critical temperature. Osmond, who distinguishes three points of recalescence for soft steel, places the critical temperature at the second point of recalescence. Tomlinson's (*Phil. Mag.*, (5), 25, 372, 1888) and Kunz's ("Program Gymnasium zu Darmstadt," 1893) experiments show also the change in magnetic properties due to a rise of temperature.

After steel has been heated beyond recalescence and is suddenly quenched in cold water, the mechanical hardening is accompanied by a corresponding magnetic hardening, *i.e.*, the permeability decreases and the hysteresis loss increases greatly. This influence of hardening is well known, and was first thoroughly investigated by Ewing. (*Phil. Trans.*, 547, 1885, or Ewing, "Magnetic Induction," &c., p. 82). Very little is known about the influence of heat treatment on such hardened steel. Barus and Strouhal (U.S. Geological Survey, No. 14, 1885) in an exhaustive paper show the influence of tempering on the retentivity of steel magnets, and are the originators of the well-known method of "seasoning" magnets by subjecting them for several hours to a temperature of 100°, which method has recently been used very successfully by B. O. Pierce. Their results, as far as they have a bearing on the subject of this paper, are, (1) that the magnetic moment of a hardened steel magnet is smaller after reheating to about 100° than it was before, and that on heating to still higher temperatures it increases again; (2) that the length of time during which the bars have been at the high temperature is of some influence, especially for the lower temperatures.

Quite recently Dr. Guthe has undertaken an investigation with a view of following the annealing process step by step, and obtaining the relations between the magnetising force, maximum induction, remanence and coercive force for each of these steps. His results are also interesting from a theoretical point of view, since they show a decided difference in the rate of change of the magnetic properties for the different temperatures.

The results of this investigation are described in a paper recently read before the American Institute of Electrical Engineers (*vide* Vol. 14, No. 3, pp. 59 to 90).

For an account of the details of the method of examination employed, we must refer the reader to the original paper, which is crammed with numerical results, both of a physical and a chemical nature, chemical data being obtained because Dr. Guthe was determined to see what influence the amount of carbon in the iron exercised.

Rings of metal were employed, the diameter of which were 12·6 cms., and the thickness 8 mms. These were subjected to an exhaustive scheme of examination, the varying constants being determined:—

(*a*) Before heating.
(*b*) Heated to 675° and quenched.
(*c*) Heated to 900° and quenched.
(*d*) Temperature for one hour at 100°.
(*g*) Temperature at 200°.
(*h*) Tempered at 300°.
(*i*) Tempered at 450°.
(*k*) Annealed.
(*l*) Re-annealed.

In addition to the table of constants, the hysteresis curves are given for the various rings employed.

The results of this research may be summarised as follows:—

1. The point at which steel becomes magnetically hardened by quenching, lies at different temperatures, according to the amount of carbon contained. It is considerably lower in high carbon steel than in low carbon steel, and corre-

sponds closely to the different temperatures at which recalescence occurs.

2. The higher above the point of recalescence steel is heated before being quenched, the harder it is magnetically.

3. The magnetic hardening produced by quenching is the larger, the higher the percentage of carbon.

4. Reheating has in general a softening effect upon the magnetic properties of hardened steel, *i.e.*, the permeability increases, and is accompanied by an increase of maximum induction and a decrease of the coercive force. But a hardening is noticeable in the low carbon steel after it has been reheated for a short time to 100°. The greatest change in the maximum induction takes place for high carbon steel between 200° and 300°, for low carbon steel between 300° and 450°, beyond which temperature there is hardly any change in the practical limit of saturation. All change taking place in reheating beyond 450° consists in an increase of permeability for small magnetising forces, *i.e.*, a decrease in the coercive force or hysteresis loss.

5. To produce strong magnets, the hardened steel should first be reheated to 450°.

6. Heating to a high temperature below the point of recalescence and sudden quenching, produces a steel with a very weak retentivity if the value of the magnetising force has been large, in consequence of which the hysteresis loss in a cycle is greatly increased. This result may also be obtained, though in a lesser degree, by annealing at a very high temperature.

The valuable paper of Dr. Guthe calls attention to the need of accurate knowledge concerning the behaviour of steel as a magnetic medium when it has been treated by heating, quenching, cooling, and annealing or tempering. Incidentally some of the considerations are shown to apply to those varieties of iron containing such low amounts of carbon as not properly to be called steel, except in relation to the process used in making them. The subject is one of great practical importance, and it is only by such experimental data as the paper furnishes that we can advance.

Dr. Guthe's paper is perhaps the most exhaustive contribution to our knowledge on this subject which has yet been produced, and those who are interested in the phenomenon of magnetisation will be very grateful to him. There is perhaps no phenomenon that is so complex as the magnetisation of iron.

It is recounted that Helmholtz, in his lectures at Berlin, whenever he came to discuss the behaviour of permanent magnets in a varying electro-magnetic field, used to stop and make a very long pause, and then finally, at the end of the pause, he would say: "When we come to permanent magnets, then I don't know whether this question holds true or not." It was a sort of stumbling block in his analysis of the forces which came into play in a varying electro-magnetic field. This anecdote of a great man sufficiently indicates the need that exists for more accurate knowledge on this subject.

In the discussion which followed the reading of the paper, some exceedingly interesting views were stated. Prof. Henry S. Carhart expounded the old carbon theory of the hardening properties of steel, and its corresponding changes in magnetic properties, and pointed out that it has been strongly opposed by the allotropic theory of which Osmond, of Paris, and Roberts-Austen, of London, are perhaps the most conspicuous supporters. This theory appears to be based on the known chemical and structural changes which the carbon undergoes when the metal is raised to high temperatures, and on the recalescence or retardation points of iron.

Osmond distinguishes three allotropic forms or iron, which he calls α iron, β iron, and γ iron respectively. For the present purpose, we need to distinguish between the α and β forms only. The α iron is magnetic, the β form non-magnetic.

The first point of recalescence, or of the retardation which iron exhibits either in the process of heating or of cooling, is from 640° to 690° C. Below this temperature, annealed low carbon iron consists almost entirely of α iron. The point of retardation of the temperature on cooling is about 30° lower than on heating, otherwise the iron exhibits another characteristic form of hysteresis. Iron containing more than about 0·5 per cent. of carbon has only this first point of retardation. It is denoted by A_1.

The second retardation point in low carbon iron, called A_2, occurs at temperatures between 700° and 750° C. Iron having less than 0·5 per cent. of carbon, and more than 0·25 per cent., exhibits this second point of retardation in addition to the first.

The question arises whether some of his facts are not irreconcilable with the theory.

Amongst others who joined in the discussion were Mr. Paul Winand and the President, Dr. Pupin, whilst Prof. Elihu Thomson made a written communication after the adjournment.

We are glad to find that the subject has been taken up by such competent hands, and that the investigation will be continued and pushed forward into the field of the unknown, for the ultimate results promise to be of the greatest use to the constructor as well as to the mere theorist.

PROTECTION OF OCEAN CABLES.*

The claim of the submarine cables to international recognition and protection is based partly upon the fact that they traverse the high seas, and partly because their termini rest within the territorial jurisdiction of different states. These circumstances constitute their conspicuous feature, and the practice of regarding them in their international aspect preceded proclamation of principles in respect of their treatment by the nations.

It soon became evident, however, that the proper protection of such cables could only be assured by enlisting the co-operation of the great powers. With this end in view, in 1869, the secretary of state, under direction of President Grant, addressed a diplomatic circular to the maritime powers, in which he expressed the conviction of the president that "the present moment was favourable for the negotiation of joint convention of the maritime powers of the world for the protection of submarine cables."

The United States, he continued, had a peculiar interest in fostering the preservation of these indispensable avenues of intelligence and in protecting them against wanton injury. The cable between Cuba and the United States had recently been cut. Experience had shown that the assumption by one nation to control the connections with the shores of another would lead to complications that would, unless arranged, result in preventing all direct communication between the two countries.

General Grant deemed that such a result could best be prevented in future by providing that hereafter no exclusive concession should be made without the joint action of the two governments whose shores are to be connected. A draft for a convention was enclosed in the circular, consisting of several well-drawn articles, whose purpose was to secure the safeguard of submarine cables from wanton injury or destruction in time of war, as well as during periods of peace. It proposed to prevent wanton injury or destruction by a joint declaration that such acts shall be deemed to be acts of piracy and punished as such. It contained provisions against scrutiny of messages by government officials.

The powers were invited to authorise their representatives at Washington to enter into a conference for the purposes indicated. The Franco-Prussian war intervened, and its prevalence, and possibly other reasons, prevented the conference at Washington. Conferences, however, were held subsequently at Rome, Brussels, St. Petersburg and Paris, where the propositions announced by the United States were zealously advocated and opposed.

At an international convention for the protection of submarine cables, held in Paris in 1884, a convention was signed by representatives of 26 powers for the protection of submarine cables in the high seas; but it was limited in its operation in general to time of peace, as appears from the terms of Article 15, which was in these words:—

"It is well understood that the stipulations of the present convention do not affect the liberty of action of belligerents."

In the year 1879 the subject of the protection of the submarine cables was much discussed by the members present of

* Abstract of communication of Alexander Porter Morse, of Washington, D.C., in *New York Herald*, July 19th, 1897.

the Institute of International Law, and the following resolutions were adopted by the Institute:—

"It would be very advantageous for the different States to agree upon a declaration that the destruction or injury of submarine cables in the high seas is an offence against the laws of nations, and to determine in a precise manner the criminal character of the acts and the punishments applicable; on this last point such a decree of uniformity would be reached as is compatible with the diversity of criminal legislation.

"The right to seize offending individuals, or those presumed to be such, may be given to the public vessels of all nations, under conditions regulated by treaties; but the right to adjudicate should be reserved to the national tribunals of the captured vessels.

"The submarine telegraphic cable which connects two neutral territories is inviolable.

"It is to be desired, when telegraphic communication must cease as the result of a state of war, that only measures strictly necessary to prevent the use of the cable should be employed, and that an end should be put to these measures, or that the consequences should be repaired as soon as the cessation of hostilities will permit."

The committee declined to adopt the proposition of the United States that the wanton destruction of submarine cables should be assimilated to piracy, on the ground that the punishment would be too severe and out of proportion to the gravity of the offence. But why should not the State, corporation or individual that would wantonly destroy this now necessary avenue of communication between the States and communities of the world be treated as *hostis humani generis?*

The end to be accomplished is the safeguard of these instruments of communication and commerce at all times. Terms are more or less inaccurate when subject to a mere verbal criticism, and the methods necessary to attain the end involve considerations not necessary to enter upon here. It matters little whether the process which secures protection is described as "internationalisation" or as "neutralisation," provided the end in view is attained.

It is patent that a public sentiment is aroused among civilised peoples which insists that war and its attendant horrors shall be avoided when possible, and that all the agencies which make in favour of the perpetuation of peace among nations shall be employed and encouraged. The internationalisation of submarine cables will draw the nations nearer together and bring home to them what interest as well as justice demands in this relation. This may be accomplished along the lines of the draft contained in the diplomatic circular addressed by the United States in 1869 to the maritime Powers. The selfish commercial interests of States, not to mention higher motives, would seem to dictate such a joint declaration.

It is noteworthy that the great submarine cables are owned and operated by private corporations or companies composed of individuals who are citizens or subjects of many different nationalities, and that comparatively few long cables are owned or operated by States. There are 310 submarine cables owned by private corporations or companies, having a length of 139,754 nautical miles, and the length of cables owned by States is 18,132 miles. There are but two great plants, one in England and one in France, for the fabrication of cables and cable supplies, and specially constructed vessels are required to lay and repair cables.

Twelve cables traverse the North Atlantic: 11 are owned and operated by American or English companies, and one by a French corporation. All of these have their termini in the territory of the United States or of Great Britain except two, which have termini in France. Three cables, one American and two foreign, traverse the South Atlantic.

The policy of the United States in reference to the landing of foreign cables within the territory, as indicated by executive action at least, is based upon considerations that are opposed to the amalgamation or consolidation of competing companies, and demands from foreign Governments reciprocal privileges for American citizens and companies. It has been assumed that the control of power to regulate the landing and operation of such cables is in the federal Government, and that the executive will exercise the power in the absence of legislation by Congress. The subject, however, is in a somewhat hazy and indeterminate state at present, and various Bills are pending before Congress to regulate the establishment of submarine telegraphic cable lines or systems in the United States.

The best thought of statesmanship should be invoked to formulate such legislation as may be appropriate and correspondent to the large subject. Nice questions as to the conflict of jurisdiction between the states and federal government may arise, which may require adjudication by the courts, but meanwhile, for purposes of defence, those avenues of international communication and foreign commerce may be regarded as subject to the power and jurisdiction of the federal government.

This subject was called to the attention of Congress by the late attorney-general, who submitted his views on one or two points, and suggested for the consideration of Congress whether it would not be wise to give authority to some executive officer to grant or withhold consent to the entry of foreign cable enterprises into this country on such terms and conditions as may be fixed by law.

"The existence," says the attorney-general, "of any executive authority over the subject is at present involved in doubt, and the United States Circuit Court, in which a recent suit was brought, appeared to be somewhat doubtful as to judicial authority in the matter.

THE ORIGIN OF THE COHERER.

A Correspondent sends us the translation of a *Note* read before the "Académie des Sciences," by M. E. Branly, November 24th, 1890, under the title of "Variations of conductivity under various electrical influences."

"In a course of experiments I used, as a conductor, a thin layer of finely ground copper,* spread over a rectangular plate of ground glass or ebonite; this layer, polished with a burnisher, has a resistance which varies, for the same weight of metallic dust, from a few ohms to several millions. The connection with an electric circuit is formed by two narrow copper bands, parallel to the short sides of the rectangle, and adjusted by means of micrometer screw. The distance apart is therefore variable.

"This conductor can be replaced by glass or ebonite tubes containing as conductor fine metallic filings, either iron, aluminium, antimony, cadmium, zinc, bismuth, &c., sometimes mixed with a liquid insulating substance. This powder is inserted between two metallic discs held by rods.

"A circuit consisting of one of these conductors (coppered ebonite or glass plate or tube with filings), and a long wire galvanometer and a Daniell battery, only allows a very small current to pass; but there is a sudden decrease of resistance shown by a wide deflection of the galvanometer when in proximity to the circuit one or several electric discharges are produced either by means of a Wimshurst machine or a Ruhmkorff coil, or by the exciter which I used in the study of the positive or negative losses under the influence of light. (*Comptes Rendus*, de l'Académie des Sciences, April 8th and 24th, 1890.)

"By making use of a Wheatstone bridge, I have been able to notice this effect at a distance of *over* 20 *metres*, while the electrifying apparatus was working in a room separated from the galvanometer and the bridge by three large rooms, and that the noise of the spark could not be heard. The variations of resistance are more or less considerable according to which of the above-mentioned conductors is used. . . . It is necessary to tap the plate over which the conducting substance is spread in order to stop the variation of resistance."

THE CASSEL GOLD COMPANY.

By E. ANDREOLI.

(*Concluded from page* 145.)

There are some men who will study scientific or industrial subjects for several years, and indefatigably make researches and experiments until they have solved the problem which

* I sometimes add a little tin, which makes the dust adhere better.

they have in their mind. There is another class of more practical searchers who, instead of worrying and toiling in investigating new fields of knowledge, prefer to imitate and assimilate what the skill and the ingenuity of others have created; they capture your ship, alter her name, and on her masts hoist false colours.

It is a peculiarity of some men who have struck out an idea, a device susceptible of a more or less useful application, that they firmly believe that nobody before them has ever thought of it. They do not know what other people have already done in the same line; they do not want to know it; they do not care for it; but very often one fine day they find out or they are shown that their invention, plan, device, apparatus, method, or whatever else it may be, is nothing new, and their disappointment is so much the bitterer that they are *bona fide*, and they were really persuaded that they had discovered something.

Mr. Alfred James, of the Cassel Gold Extracting Company, states that in the electro-precipitation of gold or silver from their cyanide solutions by the Siemens & Halske method now in use, in which an iron anode is employed, there is a considerable loss of cyanogen, owing to the metal of which the anode is formed being attacked by the cyanogen of the solution, forming cyanogen compounds, therewith to the destruction of the anode and of cyanogen in the solution.

These remarks denote a profound knowledge of the electrolytic art, and give promise of a disclosure of startling discoveries which, if they do not revolutionise the existing method for separating gold from its cyanide solutions, will at least inaugurate a magnificent series of advancements. Mr. A. James has found that by using an anode of lead, *the lead compound "formed" during the electrolysis of cyanide solutions "forms" a coating which protects the lead* from further combining with the products of the electrolysis, and thus saves the anode from much damage, and prevents the loss of cyanogen from the combination of the radicle with the metal of which the anode is formed.

Has Mr. Alfred James really discovered that in a cyanide of potassium solution a lead anode is coated with an insoluble layer? Does he really believe that he was the first to find it? Why does he not tell us how he proceeds to obtain this precious coating on a lead anode? I may also ask him whether he has any particular reason for concealing the name and the nature of this compound which protects the lead at the positive pole in a cyanide of potassium solution, just in the same manner as a lead anode in a dilute sulphuric acid solution is covered with an insoluble coating?

I had always fancied and I most sincerely confess that I still believe that I am the one who noticed that a lead plate immersed in a cyanide electrolyte is coated with a film of peroxide of lead, and who demonstrated in a very particular manner the advantages of peroxide of lead anodes which are practically unattackable either in a weak or a strong cyanide solution. Mr. Alfred James says that he does not use "peroxidised lead anodes," nor "peroxide of lead" plates, nor "peroxidised lead," and that he uses *metallic lead anodes*, and that in working his invention, the metallic lead *does not become coated with peroxide* in the cyanide solution.

If his protecting coating is not peroxide of lead, what can it be? Mr. Alfred James ought really to have told what it is, and, I repeat it, he ought to have explained how this protecting film can be obtained.

Mr. Alfred James's process has for its object the electric precipitation of gold and silver from their cyanide solutions, but in his great "precipitation" Mr. James merely claimed the use of lead anodes, and did not at all describe in what manner his invention for the electric precipitation of gold is to be carried out. If his anodes *are made of lead*, unless some special conditions are fulfilled, they will immediately be attacked and disintegrated; the solution will turn milky, and will be heavily contaminated with cyanide of lead.

If during the electrolysis they become, as Mr. James describes them, *coated with a protecting layer*, they are no more lead anodes than the anodes coated with peroxide of lead in a sulphuric acid electrolyte are lead anodes. In both cases they are *peroxide of lead* anodes. No electro-chemist will ever believe what Mr. James says, or leads us to think, that, in one single operation, he forms by electrolysis on his lead anodes a coating which protects the metal, and at the same time deposits gold on the cathode. He does not form his protecting coating in a gold cyanide solution, but simply in a cyanide solution. He does not coat his anode with a protecting layer, and his cathode with gold at the same time.

The peroxidation of lead in a cyanide of potassium solution is neither efficient nor practical. It is a prohibitory process, because it necessitates the use of a strong cyanide of potassium solution and a strong current.

One can imagine the trouble and expenditure of the peroxidation of 7,000 or 8,000 square feet of anodes, which is about the surface necessary for an installation capable of treating 100 tons of solution per day. The mode of coating lead with peroxide, *i.e.*, making peroxide of lead anodes, is after all immaterial, and I will take the liberty of telling Mr. Alfred James that the use of peroxide of lead anodes in a gold and potassium cyanide solution *is not his property*. I deposit gold from its cyanide of potassium solutions by means of peroxide of lead anodes; Mr. James says that he deposits it by means of lead, which he states he has coated with a layer of a protecting substance, the name and nature of which he keeps secret, very likely in order not to call attention to it.

I wish Mr. James would be good enough to contradict my statement that this protecting substance is peroxide of lead, and cannot be anything else, and that, according to me, Mr. James does not use lead as an anode, but that he first peroxidises the lead in a cyanide solution, or in another bath, and that he then uses his peroxidised lead as an anode.

I shall be quite ready to offer an ample apology to Mr. Alfred James if he makes, in reply to this article in the Electrical Review, a declaration proving that his protecting coating of lead anodes is not peroxide of lead, and if he can send to the editors of the paper a piece of one of his anodes electrolytically protected by an insoluble layer. Then we shall see if Mr. Alfred James uses peroxide of lead, or not, in the electric separation of gold.

The most remarkable conclusion to be derived from the instructive perusal of Mr. Alfred James's description of his process is that in gold and cyanide solutions he uses *peroxide of lead anodes*, which is the invention of the writer.

That he deposits *gold or aluminium cathodes*, and recovers the gold by washing or stripping off, which I believe is the invention of Mr. Sherard Cowper-Cowles.

And, finally, that after deposition of gold and silver, the precious metals *are recovered by cupellation of the lead cathodes*, which, as everybody knows, is the characteristic of the Siemens and Halske patents which are worked by the Rand Central Ore Reduction Company.

THE PAINLESSNESS OF ELECTRIC DEATH.

By W. S. HEDLEY, M.D.

There is a story of a great living professor who asked the question, "What is electricity?" The student excused himself by explaining that although for the moment he had forgotten it, he had known the answer to the question once. Turning to others present, the professor drew their attention to the fact that they had in their midst one of the most remarkable men that the world had ever seen—the man who had once known what electricity is. It is impossible to read the following extracts from a letter in the *New York World* of January 8th, without feeling that they supply the sequel of the above story, and that the writer of the letter is no other than the student in question, with his powers of memory now happily restored. Expert Harry L. Tyler is "consulting electrician at electrocutions." He knows (we have his own word for it) what electricity is, and it would appear that one of the interesting consequences of this knowledge is a growing danger that the death penalty may lose its terrors. He is able to assure all future "victims of the chair," that under New York's system "electrical death is painless."

In the letter referred to, this authority deplores the fact that "the majority of the individuals who go to make up the public mind believe that electricity is an exceedingly deadly substance which may be stored up or transported at will, which travels through wire like water through pipes . . . . . The term volt is generally described as denoting the pressure which forces electricity to travel, the term ampere

is pictured to denote the quantity of electricity so transported." Mr. Tyler "has discovered" that "there is no such material as electricity; further, that electrification of a body of matter consists only in impairment of the cohesion of its particles, and that all electrical effects are due to this." Is this true, and is it new? The latter question is the more easily answered. In an article by H. A. Rowland in the "Engineering Magazine," Jan., 1895, there appears the following:—"We arrive, therefore, at the conclusion that all electrification is originally produced by separating the atoms of bodies from one another. This can be done by breaking contact, by friction, or by the chemical action of one substance upon another." It is true that the whole language of electrical science suggests the idea of a fluid substance, but it can scarcely be suggested that those who, for convenience, use these conventional terms, commit themselves to the theory that such terms suggest. Even Mr. Tyler finds it necessary sometimes to fall back upon the conventional units, and it might be even more conventional still had he defined an ampere as a rate of current flow rather than as "the quantity of electricity which is so transported."

Mr. Tyler has electrified various portions of the body, and when this is done without electrifying the brain the process is agonising, and due to "the expansion or separation of the molecules of blood and tissue, because their cohesion is impaired. . . . . Where the brain is involved simultaneously with the body, the particles of that organ lose their cohesion, and their ability to reason or to realise pain is impaired in proportion to their degree of electrification." Mr. Tyler has had himself gradually electrified to about one-eightieth of an ampere with the following rather complex result:—"A sudden shock is first felt, as if someone had struck you on the head with a heavy mallet . . . . no pain . . . . the brain is benumbed. Bright lights flash before your eyes. . . . . The pulse is high, and an exhilarated feeling takes possession of you; you feel as if you were treading the air, with everything around you a blank. You are alone, the only being . . . . you gradually sink into insensibility." All this was the result of slight and gradual electrification; but in cases of execution by electricity, the electrification is instantly maximum, "and consequently it is safe to assume that the subject experiences none of these sensations; he is instantly rendered insensible." The latter point is in every way probable; but knowing as little as we do of the human body as a conductor of electricity, it can scarcely be "safe to assume" that electrocution currents instantaneously annihilate sensation. (In this connection it is, of course, necessary not to be misled by those complicated reflex movements of groups of muscles such as are seen in decapitated animals.)

It may be suggested that so far as loss of sensation is concerned, the condition most nearly analogous to the one under consideration is that state into which a person passes who has received a severe blow on the head. The leading feature is sudden loss of consciousness, great weakness of heart action and of respiratory muscles. In fact, the condition known surgically as "concussion." There is great difference amongst surgeons as to how a blow produces such effects, and upon the physical conditions of the brain after the application of such force. It is suggested:—1. The vibrations of the skull produced by the blow communicated to the brain permeate its whole mass, and suspend or destroy the vital activity of cells and tissues. 2. It used to be thought that there was no structural alteration, but more modern observation has shown that in nearly all fatal cases there are either numerous minute hæmorrhages or definite lacerations of brain substance (but these may not be the cause of the observed effects). 3. Owing to vascular disturbance anæmia of the brain is produced.

In the case of electrocution currents passed directly through the brain, it seems reasonable to suppose that a true *commotio cerebri* is produced, amounting to an actual molecular disintegration, which paralyses and destroys the function of the cerebral cells. Turning to the official record of 34 cases of "infliction of the death penalty by means of electricity" at Sing Sing prison by Dr. MacDonald (who follows the report of Dr. Ira Van Giesen) attention is drawn to the following points. "The passage of an electrical current (of approximately 1,500 to 1,700 volts and a current of 2 to 7 amperes, one electrode being applied to forehead and temples) does not do any damage to any of the internal organs tissues or muscles. None of these parts are lacerated or changed in volume, neither are there any gross chemical or morphological changes or alteration of their finer structural features . . . . microscopical examination of the tissues often shows that there are no signs of mechanical violence, such as tearing, fracture, or disintegration of the protoplasm. As to the central nervous system, "the ganglion cells seem to be normal in size, or at least do not show any striking reduction of volume." There are small pelechiæ, but "these minute haemorrhagic spots are not a constant feature of these cases."

It is clearly probable that electrocution is painless. Reverting to conventional ways of thinking, the sequence of events may perhaps be imagined as follows:—Entering the skull a current diffuses itself through the brain, sweeping away the faculties of sensation, intellect and will; concentrating itself, it makes for the foramen magnum, smiting in its path that vast collection of conducting fibres and nerve centres—the medulla oblongata. The delicate mechanism by which vital functions (respiratory, vaso motor, cardio-inhilitory, &c.) are governed is thus destroyed, and it is on the balanced relationship of such functions that the thread of life depends.

STREET RAILWAY ACCIDENTS IN THE UNITED STATES.

The increased speeds that are prevalent upon electric tramways will probably be found to result in a much greater roll of accidents and serious injuries, even allowing for the superior ease with which electric cars may be handled and controlled.

This is to some extent evident from the figures to be found in the State Railroad Commissioners' reports for the past and previous years; in Massachusetts, for instance, the total number of fatal accidents on the street tramways to passengers, wayfarers and employés during the year 1888 (when all the cars were worked by horses) only amounted to 11, whilst last year there were not less than 26 deaths due to the same cause. At the same time, however, it is to be noted that the total number of passengers carried was considerably more than doubled, so that the relative proportion of fatal accidents to volume of traffic has not materially changed.

The annexed table shows the figures for the three great States of Massachusetts, New York and Pennsylvania, for the year 1896; and underneath are also given the number of deaths arising from the steam railroad service. The latter is very clearly more dangerous than the street tramway service, so far as passengers are concerned. This is no more than would be expected; accidents upon a line more or less fenced in are obviously more likely to hurt those travelling in the trains than anyone else, whilst conversely a street tramcar usually does more damage to those it runs down than to anyone actually in the car itself.

Street Railways or Tramways.

1896.	Massachusetts.	New York.	Pennsylvania.	Totals.
Passengers carried ..	292,360,000	560,700,000	376,502,500	1,230 millions.
Miles of track	1,292	1,485	1,562	4,360
Car miles run	53,613,700	111,408,300	not given	—
Fatal accidents to passengers	10	13	32	55
Ditto to public	15	56	76	147
Ditto to employés ..	1	6	10	17
Totals	26	75	118	219

Steam Railroads.

Passengers carried ..	111,630,000	179,316,000	128,335,000	
,, killed	10	18	37	

It is somewhat curious and noteworthy that relatively so many more fatal accidents should thus happen in one State (as in Pennsylvania) than another; to judge from the figures, one can only conclude either that human life is of less value in one place than another (an obvious truism for uncivilised

regions, but hardly to be expected to such an extent in a leading country like the United States), or else that the motormen are extremely careless at the high speeds attained, and are ill provided with suitable car fenders for use on emergency. It is simply astonishing to note the indifferent way in which the great American public too often strolls across the street tracks; but probably the fatal accidents do not arise from this public carelessness so much as from the assumption on the part of motormen that everybody in danger of being run down is "*compos mentis*," and ready to jump aside at short notice. The consequence is that drunken men, would-be-suicides, and other incapables, stand a poor show.

Much the same sort of thing is seen in countries like Belgium, where there is a network of light railways running along the main roads and worked by steam. Nearly all the fatal accidents arise in this case from persons not in full possession of their faculties straying upon the track—perhaps even lying down thereon!

A reliable car fender or life guard is the best cure for this defect in street railway working, and the authorities ought in every district to insist upon its use. There are such available, and the tramway companies themselves ought to find it advantageous to equip their cars voluntarily, if only to avoid claims for damages and the unpleasant notoriety these bestow.

REVIEWS.

Electricity and Magnetism for Beginners. By F. W. Sanderson, M.A. London: Macmillan & Co.

The author, who is headmaster of Oundle School, Northamptonshire, states in his preface that the book "is *intended to form a first course for boys who have already learnt the elements of mensuration, dynamics, and heat.*" If we are correct in assuming that the boys at Oundle are given time and opportunity for instruction in the subjects above named, as well as in electricity, we must congratulate Mr. Sanderson on the up-to-date character of his curriculum from the point of view of the boy who is desirous of afterwards entering some branch of the engineering profession. But if the 240 closely printed pages comprise only the "first course" for "boys," we cannot help wondering how many will ever reach a second course.

The book is divided into four chapters, headed respectively Magnetism, Current Electricity, Electrostatics, and Electromagnetism; followed by a short appendix, and answers to the numerical exercises set at various parts of the work. Unfortunately, the author handicaps his book by omitting to provide an index; the more so as each chapter is divided into several sections, and each section into paragraphs, the numbers of which start from unity in each section.

The subject of magnetism is fairly well treated, and there are numerical examples and exercises enough to satisfy the most exacting. This, indeed, is the case throughout the book, often, we fear, to the exclusion of more legitimately elementary matter. The following will give some idea of the scope of the exercises in the magnetism section:—P. 44: "*To show that the time of vibration of a magnet depends upon the mass and shape of the vibrating body.*" P. 53: "*To compare the intensities at points in the aerial line or equatorial plane of a magnet with the earth's horizontal intensity;*" and, again, p. 60: "*Given the intensity of a parallel field, to find the magnetic moment, the axis, and the strength of the poles of a magnet,*" and so on.

In Chapter II., the first thing one notices is that the simple, Smee, Bunsen and Daniell, are the only primary cells selected for notice; and that "*voltaic or galvanic cells*" are defined as "*vessels fitted with material to furnish a current of electricity.*" What about secondary cells, of which, by the way, we cannot find any mention? One also experiences a decided shock on finding that Bunsen cells are to be used for most of the experiments. Fig. 43 gives an excellent illustration of a home-made tangent galvanometer with different sized coils, with the drawback, however, that the needle is relatively too large to give accurate results with the smallest of the coils. This apparatus is used in quite a number of experiments and tests that would seemingly necessitate a much more delicate instrument; in fact, we fail to find the mention of any other form until the appendix is reached, when a description of a reflecting and ballistic galvanometer is given. So often is the tangent galvanometer mentioned, that it is provided with a special abbreviation "T.G." Later on one finds "E.C.E." used for electro-chemical equivalent, "E.M.U." for electro-magnetic unit, "E.S.U." for electrostatic unit, and so on. This practice is very well in its way, but it is a bad habit to get into, for a student might subsequently find the use of unfamiliar abbreviations in his exam. papers greatly to his disadvantage.

On pp. 85 and 86 the reader is instructed how "*to find experimentally the current in amperes required to ring an electric bell:*" the method involving the use of a "T. G." and the conversion of the absolute to the practical value. We feel in doubt as to whether we should smile or nod approval at this. Speaking of current, the author remarks (p. 95) "*It will be shown when we come to static electricity that the modern conception of a current of electricity is a flow of tubes of induction in a medium, the ends of the tubes flowing round the circuit.*" Will not the "beginner" find this rather hard of digestion? If not, his powers will find ample exercise in other statements of a similarly advanced character. *Eg.* the E.M.F. of a cell is defined as "*The quantity of work which is done in the circuit of a cell when the unit quantity of electricity passes round it.*" On p. 114, E.M.F. is used in the sense of P.D., an unfortunate mistake. On p. 141, megohm and microhm look very awkward when written "meg-ohm" "micr.-ohm."

The second chapter bears a distinctly less satisfactory impression than the first, and when we reach the third (Electrostatics) we find much to grumble at. Looking through the illustrations to start with, one is repeatedly confronted with a ridiculously old-fashioned form of electroscope, and apparatus "insulated" on simple glass legs, though there is one exception in the latter respect, viz., fig. 79. Surely every teacher must know that experiments with such apparatus are most difficult to perform under the usually unfavourable atmospheric conditions, and the results obtained often very misleading. It is recommended that sulphuric acid be placed inside the glass flask which supports the electroscope; about as efficacious a proceeding, in its way, as the ostrich trying to hide itself by burying its head in the sand. It is high time that the electroscope and insulating stand of Ayrton & Perry received recognition at the hands of text-book writers, considering that it is 12 years or so since they were devised.

The apparatus for Blot's (Cavendish's?) experiment (fig. 65) with close-fitting hemispheres simply would not give the desired result, for part of the charge would go back on to the sphere at the moment of removing the hemispheres; again, one is surprised to find no mention of any other "electrical machine" than the electrophorus. Section IV. of Chapter III. deals with the electric field, and some instructive matter relative to lines of force is given; this being also the case in the magnetic and electro-magnetic sections.

Chapter IV. is divided into four sections, dealing respectively with the current's field, the interaction between the fields of a magnet and a current, the mutual action of two currents, and the induction of electric currents. Only some 30 pages are devoted to this, and most of these are given over to very theoretical matter: many well known and important experiments being conspicuous by their absence. Under the heading of "*Practical Applications of Induced Currents*," the telephone receives scant consideration in 15 lines, the microphone in 10, the dynamo in 8, the "Ruhmkorff's induction coil" in 11, and the transformer in 6!!

We opened this book in considerable hope that it would justify its year of publication, and we close it with the conviction that the author has missed his opportunity. The style and matter is too academical, and we all know what that means when applied to electrical literature: though the dabbler in absolute units will find plenty here to satisfy him.

Taking the work all round it abounds in good points, but these are submerged in a mass of unnecessary matter. The "beginner," if he has not a good knowledge of mathematics, and the grounding in the subjects mentioned at the beginning of this notice, will find the book very difficult reading. Very few real beginners in this subject actually come up to

the intellectual standard required by Mr. Sanderson, and we regret to have to express our conviction that the title of the work is a misnomer.

Electric Smelting and Refining. By Borchers & McMillan, pp. 416. London: Charles Griffin & Co., Limited, 1897. Price 21s.

This is a translation of Dr. W. Borchers's "*Elektro-Metallurgie*," by Mr. Walter G. McMillan, with copious notes and additions by the translator. The author and translator do not always coincide in opinion, nor in their statements of alleged facts. This may be taken as a case of "doctors disagreeing." Who shall decide?

For whose benefit is the original comprehensive title, "*Elektro-Metallurgie*," changed to the insufficient one of "*Electric Smelting and Refining?*" A new title don't make a new book. The translator's notes and additions are enclosed between brackets. This is excellent, because it facilitates the reading, and in many cases distinctly separates the old from the newer material additions—if we may be permitted to use the term "old" in reference to that art which is so recent in extensive practical applications. The translator truly says in his preface:—"During the few months that have passed since the publication of the German edition, progress has been made in many directions. The translator has therefore ventured to add notes here and there, in the hope to bring the work more nearly up to date."

Unfortunately the "up-to-date" work on "Electro-Metallurgy," beyond stating in the compass of a few pages the principles and laws of electrolysis and of the production of heat under the formula $c^2 R$, consists mainly in the chronicling of failures. Some of these never got beyond the brain and pen of the men whose names identify the "processes," and others are more or less dismal failures which have cost much time and money. But *Experience*, the best teacher, has been gained, and its record points out the rocks, rapids, shoals, and quicksands which might also wreck others who have not studied the charts now so fully opened in this book.

Some wise man has said that "more is to be learned from failure than from success." Haphazard success does not call for, nor command, the study of the reasons why and wherefore which failure does.

There are over 50 electrical "processes" referred to, of which only two or three are practised commercially, for the production of aluminium. This metal seems to have received the most attention from electro-metallurgists and "inventors." The latter name is used, in the idiom of Artemus Ward, "sarkastic like."

There are eight processes for antimony, 10 for copper, 10 for gold (Minet's, which is coming, *vide* Electrical Review, July 23rd, 1897, is not included), 14 for magnesium, 15 for sodium, and 20 for zinc. Various of the other metals have from two to six. The very small percentage of these processes which is in every-day use points to the great number of failures, which are such for various reasons. Some of these failures are from impracticability and ignorance, while others are from impecuniosity.

We have not the time, nor the space in which to print the comments, to go into an extensive examination of the exactness of all of the statements. But casually we have noted a few:—

Page 346. "Antimony. *Properties of the Metal.*—Antimony (Sb; atomic weight = 120; specific gravity = 6, 7), the most *metal-like* of the *non-metals*, is white . . . ." Whereabouts in Ireland was that statement found?

Page 5. "An *Ampere*, the unit of current strength, is equal to a coulomb per second." This is carelessness on the part of author, translator, or proof reader.

Page 281. In describing Keith's process for obtaining gold, the quantity of mercury salt added by Keith to his solvent is stated as "6½ to 13 lbs.," when the actual amount is from 2 to 10 ounces, according to the original paper in the *Transactions of the Institution of Electrical Engineers*, March, 1895. The author omits to state in his description of this process that the gold and mercury are electrolytically deposited simultaneously on the cathode plates *as an amalgam*—a very important feature of the process.

His statement, "It remains to be proved whether in practice the greater expenditure on the electrolyte, the anodes, and the diaphragms, which are notoriously wanting in durability, will be compensated for by a higher yield of gold," shows an ignorance of the principles and of the description of the process.

Page 336. The criticism of Keith's process for obtaining refined lead would scarcely have been written and printed had the author read the description of the process, as practised, in the *Transactions of the American Institute of Mining Engineers*, Vol. xiii., page 311, *et seq.*

Unfortunately, the author throughout the book keeps quite consistently to his idea that in nearly all cases the German electro-metallurgists, and their processes, are much superior to those of other nations. The translator has put forward some facts which seriously call into question this assumption; *e.g.*, the Hall Process, page 149. It is to be hoped that a critical and extended examination of the material facts would not expose many more prejudiced statements, to say the least.

The book is well printed on good paper, and is, altogether, a creditable piece of work. It is a near approach to a complete compendium of the existing state of the art. Some more information as to processes which, in their day, attracted favourable attention, relating to tin scrap, copper, lead and zinc crusts, &c., may be found, by reference to *Transactions of American Institute of Mining Engineers*, Vol. vi., p. 458; *idem*, Vol. x, p. 312, and British patent 1,346, '77.

Gas, Gasoline, and Oil Vapour Engines. By Gardner D. Hiscon. London: E. and F. N. Spon. New York: Norman W. Henley & Co. 1897.

In his preface the author refers to the entire absence of any literature on explosive motors as made in the United States, and states that European books scarcely allude to American practice or American engines. Curiously enough the present book is itself one of the best proofs that such reference would be unnecessary.

The gas engine has made very little progress in America, chiefly, we think, because of the high cost of illuminating gas, and we cannot help thinking that Americans have very little to regret in this matter, for their bad and costly gas has been the making of the American electrical industry. What would be the position of the English electric light companies if they had to compete with poor gas at 7s. 6d. per 1,000 feet, instead of with fairly good gas at from 1s. 10d. to 3s. only? We venture to think the industry would, as in America, have overflowed in the direction of electrical tramways. In looking through this book we find, as above stated, ample proof that European authors had no need to make much reference to American gas engine practice, for this American book is one mass of reference to European practice. American-made gas engines or oil engines work on the Otto cycle, and are built on European patents, with such slight modifications as may commend themselves to the minds of manufacturers.

In fact, so long as the Otto cycle maintains its leading position, all gas engines, whether European or American, might just as well be made of one standard pattern and interchangeable.

True, Mr. Hiscon has something to say about European ideas being "adopted here with the spirit of American enterprise," and so on, but we may look on this phrase as the conventional sign of the conscious ego which so many Americans appear to consider necessary as a sacrifice on their country's altar.

Dealing with the theory of the gas engine, the author first deals in an elementary manner with the laws of Boyle and Lussac on the volume and pressure of a confined gas. He then discusses the question of deferred combustion, which he attributes to imperfect mixture of the gas and air at the time of ignition, and he notes that pressures do not attain to the theoretic, though he does not appear to hint, in this connection, that he has any doubts as to the specific heats of gases under high temperatures. The question of compression is dealt with, and the conclusion advanced that future practice will see compression only extend to from 40 to 60 lbs.

The coldness of the cylinder, so far found necessary, is accepted as a waste, and hence piston velocity must improve the useful effect. As shown by the Simplex engine trials in

France, a saving of 7 per cent. followed upon a raising of the cold jacket temperature from 141° F. to 265° F., while in an Otto engine 9½ per cent. was saved by raising the temperature of jacket from 61° to 140° F. Jacket temperatures now left to care for themselves, ought, therefore, to be adjustable, and the inner ball surfaces or clearance areas should be a minimum. It is, we fear, too much overlooked that the cold jacket is introduced merely as a mechanical means for keeping down the cylinder temperature to a point that will not damage the piston and working barrel. A steam engine will run well at 400° or higher. Why cool a gas engine to 120°? Yet many think that 120° is a maximum for a gas engine jacket. To reduce the loss from cold walls the spherical clearance has been evolved, the volume for a sphere being the largest possible ratio to its containing envelope, and Dugald Clark found that he saved gas by keeping up the jacket to boiling point, and favoured a still higher temperature.

The author next deals with the economy of the gas engine for electric lighting, detailing the volume of gas used in various engines per H.P. hour and per kilowatt, and even with gas so high as $1.50 per 1,000 feet he finds an economy.

One of the best chapters in the book is that on gases and liquid fuels for gas engine purposes, following which is one on cylinder capacity. Excepting that a chapter on Heat Efficiencies seems to have slipped into the middle of the following chapters, all the rest of the book has more or less the character of an illustrated descriptive catalogue of engines. The general appearance of all these American engines differs little from that of European models.

Engines are shown in various pump combinations. The book is good enough in its way, but it is questionable if a new work on the gas engine is yet required.

The illustrations of American engines are almost entirely perspective pictures from photographs of mere external views, and therefore of no real value in showing construction. Half the book, as we have said, is mere description, and many of the descriptions are little better than paraphrases of each other. Indeed, what fresh can be said of a four-cycle engine with valves of poppet type!

Experiments on Steam Boilers. By B. Donkin and A. B. W. Kennedy. London: Offices of *Engineering*. 1897.

This book is a reprint of matter that has appeared in the pages of *Engineering*, and consists of reports of a series of trials made with different types of boilers, all being fired with Nixon's navigation, carefully mixed for uniformity, but no attempt was made to find the dryness factor of the steam turned out.

The figures obtained will be useful for purposes of reference. They do not show a very close approximation between the steam temperature and the temperature of the exit gases, but appear to show what is probable. The analysis of furnace gases is also very useful as serving to show the ratio between the C O_2 and free oxygen indicative of excessive air.

In this exit gas temperature nothing supernatural is observable, showing that where brickwork is in order and leakage is kept down the low temperatures sometimes claimed to be got with these boilers is not secured.

Is it not, however, a little late to publish in 1897 a series of tests made in 1887?

The Organised Science Series. First Stage Mechanics of Fluids. By G. H. Bryan, Sc.D., F.R.S., and F. Rosenberg, M.A. London: W. B. Clive, University Correspondence College Press, 13, Booksellers Row, Strand, W.C.

This book is specially written for the purposes of the elementary examination of the Science and Art Department on Theoretical Mechanics of Fluids. The authors have taken the somewhat unusual course of practically combining a treatise on solids with that of liquids, on the assumption, we imagine, that there are students who are likely to wish to deal with the subject of fluids alone. We think that this is a very unlikely supposition, though doubtless the authors have some reason for dealing with the matter in the way they have. The introduction of numerous "cautions" and illustrative examples which help to prevent false assumptions by the student are a valuable feature in the book.

First Stage Physiography. By A. M. Davies.

This is one of the same series as the foregoing, and is written for students studying for the Science and Art Department Examinations. The book is a well-arranged treatise and is both helpful and interesting.

Dynamos and Electromotors: How to make and run them. By Paul N. Hasluck. London: Cassell & Co.

A little work published at a 1s. with a somewhat pretentious title, it is really a work for schoolboys, as the dynamos and motors treated of are only toys, the largest machine described is for an output of 440 watts or ½ horse-power approximately.

So far as it goes, it is a book which will help students and youths in constructing small machines, the designs are simple, and for such small machines effective. The information is accurate enough, and sufficient as a guide to those with a desire to construct working models of the motors and dynamos described in the book, the illustrations are good, but it is very doubtful if it conveys any knowledge or information of real value in constructing or running motors and dynamos other than the toys described.

CORRESPONDENCE.

Commutator Bars.

Our attention having been called to Mr. Theodore Stevens's letter in your issue of 23rd ult. *re* our commutator section list, we should like to point out that the form in which the dimensions are given is that which electrical engineers have themselves chosen in ordering their sections, the list being simply a copy of the particulars given us with orders, for which we have made and kept the necessary tools.

We quite admit that the form is not convenient for the designer, but Mr. Stevens appears himself to realise the difficulty in many cases of arriving by calculation at the way in which the bars are intended to be built up, and as we have now upwards of 1,000 different sections, we are in hopes that before long we may have exhausted the varieties of commutator construction, and that the designer may be able to find in our list any dimensions that he may have arrived at.

We have latterly requested that the number of sections in the commutator be stated on orders, because, assuming the use of parallel mica, we are enabled to use an angle gauge, and ensure greater accuracy than by measurement of the edges, and if engineers would adopt the system of specifying the angle between the inclined sides, together with the width and the thickness on thick edge, or both, instead of merely the three dimensions, as at present; and at the same time one of your readers would, for a reasonable sum, calculate out our list on this system, we should be pleased to re-issue it up to date, classifying the sections by the angles, or number of sections, in the circle.

Thos. Bolton & Sons.

Rushmore Dynamos.

The dynamos described under this title may be new to Mr. Rushmore, but they are by no means a novelty to electricians on this side.

I patented this method of obtaining different circuits from one dynamo in the year 1882. Since then it has been re-invented, and patented by several others in Germany and here.

It is not of much advantage in ordinary work, and in my own 15 years' practice since my patent, I have only found two cases wherein it could be advantageously applied; hence although well known, such machines are not common in use.

Rankin Kennedy.

Electric Pumping Plant.

Mr. George Broughall's letter on this subject raises an old question which has again come up for settlement, namely, the alternating *versus* continuous current systems of electricity supply.

Years ago I did a good deal in support of the alternating systems, as at that time it did show advantages over its rival. But now the case is totally different, and I don't believe the most enthusiastic alternating current advocate could demonstrate a single advantage for the alternating current in any extended system of supply. The introduction of transformers into any system is at this date a mistake; they are entirely superfluous, as they cost and waste more than they save.

Mr. Kilburn Scott's description of the pumping plant is interesting and opportune.

R. Kennedy.

Dynamo Calculation and Classification.

Re article "A New Basis of Dynamo Calculation and Classification." Should not the value of $\frac{M}{d}$ in Example 2, be 2·168, instead of 2·32 as given. An error in this value makes a considerable difference in the value of the "Induction Factor." I give my working below.

C. V. Morgan.

Determination of the above value;—

$$\frac{M}{d} = \frac{E}{11{\cdot}2\,v\,s}\left\{1+\sqrt{1-\frac{8\,B\,T\,S}{E^2}}\right\} \qquad (7)$$

$$\frac{156{\cdot}2}{11{\cdot}2\times 1\times 10{\cdot}7}\left\{1+\sqrt{1-\frac{8\times{\cdot}029\times 5{,}500\times 10{\cdot}7}{(156{\cdot}2)^2}}\right\}$$

$$1{\cdot}303\,\{1+\sqrt{1-0{\cdot}5597}\}$$

$$1{\cdot}303\,\{1+0{\cdot}6636\}$$

$$\therefore \frac{M}{d} = 2{\cdot}168.$$

Disturbances in Submarine Cable-Working by Electric Tramways.

As you clearly point out in your issue of May 21st, the only way in which a trolley disturbance can be neutralised is by another disturbance properly applied and varying synchronously. In balancing for duplex working, most of us are pretty familiar with the various adjustments whereby the outgoing waves of E.M.F. in the cable and A.L. circuits, are made to pass the ends of the receiving branch in equal phase. I had, however, hoped that some light would be thrown, not only on the picking up of the compensating disturbance, but on the correct way to apply it after being synchronised. I trust, if any other experiments in this direction were made, that they will be made public.

In the discussion at the Institution, Mr. C. Bright remarked on the brutal method of getting over the difficulty which was adopted, and I have thought it might interest some of your readers to know that, without resorting to "brute force," the problem of neutralising heavy trolley disturbances on the Western Union ocean cables running underground through Brooklyn, N.Y., has been ingeniously and successfully solved by Mr. Lynch, in charge of the Western Union cables in New York city. To fully appreciate the importance of this it must be remembered that Brooklyn has one of the most extensive systems of electric tramways in the world with a total current of thousands of amperes. The underground cables are paralleled and crossed in all directions by trolley roads for ten miles, and at times during periods of sleet and melting snow sparking and flashing at the car wheels and trolleys are very severe. These conditions are probably the worst that any underground cables, worked by siphon recorder, are subjected to. No doubt every case has its peculiarities,—the peculiarity of the Brooklyn case being the gigantic scale of the disturbing cause. The compensation, I may add, is perfect for all sorts of weather.

As one of the "noble army" of cable officials on foreign service, I thoroughly endorse what Mr. Wilkinson writes in your issue of April 30th. We are constantly being "brought up with a round turn" against difficulties which have probably been successfully overcome in other parts of the world, and it is of the utmost importance to keep abreast of the latest developments. Without detracting from the technical value of the *Journal* of the Institution, I would merely say that the technical journals are looked forward to quite as eagerly.

A. Davidson.

Lima, Peru.

TELEGRAPH CLERKS VIEW OF THE DISPUTE.

The statement of the Postmaster-General appears on p. 225, and the following interviews with the representatives of the clerks show the opinions held on the Duke of Norfolk's statement.

In an interview on Tuesday, reported in the daily press, Mr. Charles H. Garland, Secretary of the London Branch of the Postal Telegraph Clerks' Association, who represented the case of the clerks before the Postmaster-General (the Duke of Norfolk) and the Financial Secretary to the Treasury (Mr. Hanbury) at the recent Conference at the House of Commons, said he unhesitatingly declared that the outcome of their representations would be regarded with wholesale dissatisfaction, and that a protest against the Duke of Norfolk's reply would be immediately prepared and sent in. "Our principal grievance," he said, "is the reduction of the maximum salary from £190 to £160. We regarded this as something on a different basis to any of the other questions that we laid before the Tweedmouth Committee. The question here was rather the abolition of one of our vested rights, whilst, in the other cases, we were asking for an improvement. The matter that we complained about before the Postmaster-General in respect to this limitation of salary was a violation of our vested rights and a breach of contract. We are now left with £160 a year as a maximum, with no prospect of going to our legitimate remuneration of £190. It is true that 40 senior clerks are to be made supervisors, and that leaves 40 vacancies in the senior class, to which ordinary operators can go, but only about 40 out of 2,500 can get these appointments in London, whilst, in the provinces, the ordinary operators will get no benefit at all from this, because there these new vacancies do not arise. The result of the confirmation by the Duke of Norfolk of the finding of the Tweedmouth Committee with respect to pay is, that no clerk remaining in the service till his hair is gray will be able to get more than £160 a year. The next point is the question of the five years. We claimed that men, after five years' service, were not getting enough to live upon. Although they were, on an average, 21 years of age, their salary in the provinces would be only 22s. a week, and in London £63 a year. We laid this matter before the Tweedmouth Committee, and pointed out how these boys were half-starved, despite the fact that they were doing very efficient work, for they were first-class operators. The departmental experts backed this view up; but no solution has been offered to the difficulty. This class of clerks have been offered a rise of 2s. a week if they pass an examination, which will cost them at least £15 to prepare for, besides the sacrifice of time. The conditions which have been imposed upon obtaining this meagre benefit of 2s. a week are of a prohibitory character almost in the case of lads living in London without any means beyond their small salaries. Our public agitation has been confined to these two subjects and to that of the summer holidays. We complained that certains portions of the staff received their holidays only in the winter months. The Tweedmouth Committee recognised that the request for summer holidays was natural. You can see how far we have got beyond the Tweedmouth Committee when you read the Duke of Norfolk's circular. The Postmaster-General recognises the hardship, and then simply promises to consider whether some means can be found to bring about an improvement. It seems to us that, as in the past, it is simply postponing the matter to the Greek Kalends, that the scheme they are going to devise may come some day or begin to come, but that it is rather doubtful it will ever be of any benefit to the men now young in the service. On these three points the men feel that they have been treated by the Duke of Norfolk and Mr. Hanbury with as little sympathy and as little consideration as they got from the Tweedmouth Committee. To-day the men in the Central Office, with whom I have come into personal contact, have, I am sorry to say, been making some rather disorderly demonstrations, and undoubtedly their feeling is at fever pitch about the matter. I have received, in my capacity as secretary, memorials from several divisions, asking for a mass meeting to be called to decide upon some very strong measures. No doubt if the measures which these ardent spirits wish to see adopted were taken, the result would be to eventually dislocate the telegraphic service of the country. It is now in a very congested state, as the complaints in the newspapers show. Telegraphists, it must be remembered, and as the officials admit, are not to be picked up in the street, and the authorities are now at their wit's end to find enough to cope with the work, although the men are working three, four, and five hours per day overtime. What would happen in the event of their declining to perform overtime for the very small amount allowed; or again, what would be the result of a total cessation of work, can perhaps be as well imagined as described. We shall decide in committee what to recommend. We intend to be very careful to first take the opinion of the clerks all over the country, in order to see how far we shall be supported in any action we may take. The line of action to be decided upon will be determined by ballot. Whatever is done

will be very expeditiously carried out, and I can safely say that the end of next week will see us with a settled policy as to what we shall do, and I trust that a very few days after that will see us in the midst of doing it."

Mr. Garland informed another reporter that the men felt that they had been deceived, and that the authorities only waited for the prorogation of Parliament, and a consequent diminution in the pressure of work, to thwart their wishes. There was only one point in which any advantage had been secured, and that was the question of a technical examination, but that carried with it no monetary advantage, and no prospect of monetary advantage except in a very indirect way. Out of a total staff of over 3,000 at the Central Office only 80 had been benefited by the award—40 in the junior class and 40 in the senior class. The clerks had practically made no advance at all under the award.

Mr. Cheeseman, secretary of the Fawcett Association, which represents the sorting forces, said the Conference had been absolutely abortive. It was true that certain small advantages were offered to the sorters, but as for any scheme for benefiting the general body of men there was none. The sorter-telegraphist scheme would only have the effect of setting class against class. He had no doubt that the latest failure of the heads of the department to meet the demands of the staff would give a great impetus to the movement that had already been started in the service for direct representation in Parliament. Mr. Cheeseman added that an executive meeting of the Fawcett Association would be held as early as possible to consider the position of affairs and to try and bring about some united action throughout the service so as to obtain a redress of their grievances.

The opinion among the telegraphists in the Edinburgh Post Office with regard to the Memorandum of the Postmaster-General is that the reply should tide the authorities over their present difficulty without guaranteeing them against a recurrence of the agitation in the course of a few years. Satisfaction is expressed at the abolition of the technical examination; but great disappointment is felt that the holiday grievance is left untouched.

The delays in the Telegraph Department of the Liverpool Post Office have of late given cause for complaint on the part of commercial men in that city. The Chamber of Commerce has brought considerable pressure to bear upon the Postmaster-General with a view to an improvement, and as a result it has been intimated that the staff will be augmented by 60 clerks, though the task of locating them in the present inadequate building will be far from easy. It will be 12 or 18 months before the new General Post Office will be available.

AUSTRALASIAN NEWS.

[FROM OUR OWN CORRESPONDENT.]

The projected electric tramways in Sydney are progressing slowly, the various contracts being allotted in an apparently desultory fashion. The tenders for the generators for the Rose Bay line were awarded to Messrs. H. H. Kingsbury & Co. for General Electric Company's manufacture so long ago, that the field magnet frames have been delivered and are disconsolately reposing outside the power-house, where they have been for some weeks now awaiting a permanent resting place; in the meantime there appears to be no thought of laying the rails or erecting the overhead work on this line. On the George Street line tenders were let for bonding rails to Messrs. Noyes Bros. for Edison-Brown plastic bonds—the rails are not laid yet—at £100 per mile; then tenders for wrought-iron poles went to the Foreign Agency Company at £7 and £10 each, and now at last Messrs. H. H. Kingsbury & Co. have again been successful in their tender for General Electric Company's generators at £38,119, delivery to be made within 46 weeks. Messrs. Kingsbury & Co. put in 30 alternative tenders, ranging from £31,399 to £38,299. The Minister for Works has not yet decided whether the roadway will be constructed by day labour or contract. Governments latterly have had a penchant for day labour, the subways for telephone wires have recently been completed on the day labour system, and, to say the least of it, do not appear to have been entirely satisfactory. In view of this fact, no doubt the Minister will deliberate carefully ere he commits himself again on this question in relation to the tramways. The estimated cost of the line is £130,500. In the tenders for the extension of the North Shore line to Willoughby, Messrs. H. H. Kingsbury were once more successful in their tender for the generators at £1,453; Messrs. Gibson, Bottle & Co., supplying chloride secondary batteries at £875.

The electric traction scheme for Perth (W.A.) is now well on its way, the contract having been signed between Mr. G. Leake, M.L.A., representing the syndicate, and the Mayor of Perth, on behalf of the City Council, and a deposit of £5,000 lodged by the syndicate as a guarantee that the conditions of the contract will be duly and expeditiously fulfilled. The system totals over 17 miles of streets, and the routes taken cover all the principal thoroughfares of the city and surrounding suburbs, and is to be completed and in working order by October, 1898.

A short time ago a deputation from the electrical and engineering associations of N.S.W. waited upon the acting Premier with a request the Government should as soon as possible introduce a General Electric Lighting Act, as has already been done with good results in Victoria and Queensland. The deputation were informed that a Bill had already been drafted for presentation this Session, and the acting Premier promised that he would endeavour to have it referred to a select committee, in order that the opinions of the leading electrical engineers might be obtained as to the efficacy of its provisions.

Under the Victorian Act quite a number of electric lighting orders have been granted during the month past; the A. W. Alcock Electric Light and Power Company received an order for their lines and works erected prior to July 16th, 1895, with a right to apply at a later date for an extension of the area. Similar powers have been conceded to the New Australian Electric Light Company, Limited, another Melbourne company. A third metropolitan company, T. T. Draper & Co., are making use of the Corporation poles, and it was decided before granting an order to obtain a description of the works verified by the City Council. The inland towns which already have or purpose having electric lighting works also sought authority for their undertakings. An order was issued to the Bendigo Electric Company, and one promised to the Ballarat Electric Supply Company, on receipt of a verified plan of circuits. The Geelong Electric Supply Syndicate applied for an order for new works, and this was granted for a period of 30 years provided 1 per cent. of the proposed expenditure be deposited and the price fixed not higher than sixteen shillings per twenty B.O.T. units with tenpence per additional unit. The application of the Melbourne City Council for public and private lighting privileges over its entire area has also been before the minister for approval. The proposal was strongly opposed, the gas company and electric light companies joining issue as against a common enemy, and objection was taken on behalf of the Metropolitan Gas Company; the A. U. Alcock and New Australian Electric Companies; and Mr. W. Burchall on behalf of a section of the ratepayers. It was argued that it was unfair for the corporation to enter into competition with the companies already engaged in supplying light for private purposes. They alleged also that the ratepayers had not had the matter laid before them in detail, and were not aware that the City Council had neither the machinery, lines, nor the staff necessary to undertake private lighting. The Minister said that these objections should more properly have been taken when the Bill was before Parliament. He had nothing to do with the wisdom or unwisdom of the Council taking up private lighting, and on the merits he felt that the order should be granted, but he was not quite satisfied that the statutory 14 days' notice had been given the members of the Council of the meeting called to deal with the matter, and he would take time to consult authorities before deciding. Municipal electric works for Hawthorn, a suburb of Melbourne, are under discussion by the Local Council. Application is being made for power to construct such works under the Act, and the electrical engineer of the City of Melbourne is to be asked to advise the Council. A conference of aldermen, representing the suburban municipalities of North Melbourne, Essendon, Hemington and Kensington, took place at Hemington at the end of May for the purpose of considering the advisability of establishing a joint electric light supply. After considerable discussion a sub-committee was appointed to make inquiries and report to a future meeting of the general committee.

The Brisbane (Q.) Municipal Council have decided to adopt electric lighting, and have commissioned Mr. T. Hesketh, the Government electrician, to prepare a report and submit a draft scheme and estimate.

In Western Australia the Kalgoorlie Council have expressed their preference for carrying out an electric lighting scheme themselves rather than grant the right to capitalists who have applied for the necessary permission, and with that end in view, have started well by deciding to raise a loan of £10,000 for the purpose. A local company has been formed for electrically lighting the city of Kanowna, and the Municipal Council are inviting proposals from persons wishing to obtain electric lighting concessions.

The Kanowna Company is being formed with a capital of £20,000, in £1 shares, to acquire the lighting concessions already granted by the municipal authorities to certain gentlemen. The promoters are to receive 2,000 fully paid up shares in the company, and £1,500 in cash, in respect of the concessions, and to cover outlay for surveying, &c. An estimate published with the prospectus puts the initial outlay at £3,000, the annual expenditure at £1,524, and the annual revenue from six arc lights, which the Council agrees to take, and 500 incandescent lights, at £5,800, which indicates a very high price per unit, or some slight error in calculated consumption.

In New South Wales several municipalities, Albury, Goulburn, Narraudera, Coonamble and Nowra, are still nibbling at electric lighting. A committee of the Albury Borough Council recommended the establishment of electric lighting at an estimated cost of £4,000, a loan of £5,000 to be raised by debentures. The council at present pays £350 per annum to the gas company for street lighting. The Goulburn Council invited applications from electrical engineers willing to advise them, and have got off very cheaply, Mr. Norman Selfe, M.I.M.E., &c., of Sydney, offering to draw up a "general" specification for 10 guineas, the estimated cost of the works being some £7,000.

Private enterprise in South Australia is paying some attention to electric power supply as an investment, and the South Australian Electric Light and Motive Power Company are bringing before the Legislative Assembly a private Bill, giving them authority to supply electricity in Adelaide and elsewhere for private and public purposes; and early last month at a meeting of influential men held in Adelaide, it was decided to form a company to carry out the necessary work for introducing a system of electric traction for Adelaide and suburbs instead of the present horse cars.

The contract for the supply of two additional sets of machinery for the extensions to the Launceston (Tasmania) Municipal Electric Lighting Station has been given to Messrs. Siemens Bros. & Co. The Yarban electric power scheme has fallen through owing to the promoters failing to deposit £500 within the time mentioned by the Enabling Act.

An Engineering and Electrical Exhibition was opened in Sydney

on June 26th, and shows promise of considerable success, among the electrical firms exhibiting are the Brush Electrical Engineering Company, Messrs. Crompton & Co., the Edison-Swan Company, the India-Rubber and Gutta-Percha Company, Messrs. Siemens Bros. & Co., Messrs. H. H. Kingsbury & Co., representing the General Electric Company of America and the Western Electric Company, Messrs. John Fowler & Co., Messrs. Gibson, Battle & Co., representing Messrs. Mather & Platt and the Chloride Accumulator Co., the General Electric Company (Eng.), Messrs. Edge & Edge, representing W. T. Henley and Co., Epstein Accumulators, Interior Conduit Company, Jandus Arc Lamp, &c.. Messrs. Hamilton & Routledge (who are carrying out the lighting of the exhibition), the Callender Cable Company and others. The exhibition is to be open till the end of August, and is under the auspices and direction of the Engineering and Electrical Associations of N.S.W.

Sydney, *July 5th*, 1897.

LEGAL.

Montevideo Gas Company, Limited.

In the Chancery Division of the High Court of Justice, on Monday (August 9th), Mr. Justice Byrne sanctioned a petition by this company for an extension of its memorandum of association by adding power to produce, store, distribute, and otherwise deal with electricity, &c. The company was incorporated in 1872 with a capital of £600,000.

An Aluminium Company's Patent.

In the action of the British Aluminium Company, Limited *v.* the Aluminium and General Foundry Syndicate, Limited, counsel for the plaintiffs moved Mr. Justice Kekewich for judgment, nobody appearing for the defendants, in respect to an alleged infringement of the plaintiffs' rights in certain processes for the preparation of aluminium.

His Lordship, having perused the papers in the case, said the necessary formalities seemed to have been complied with, and he would give judgment accordingly.

Sir W. E. J. Vavasour's Bankruptcy.

At the London Bankruptcy Court last Tuesday, before Mr. Registrar Hope, the case of Sir Wm. Edward Joseph Vavasour, Bart., was on the list of public examinations. The debtor, who is described as of Alexander Square, W., Hazlewood, Tadcaster, Yorks., and Draycott, Stoke-on-Trent, has during the past 12 years devoted the greater part of his time to the study of electricity, and has invented various improvements in electrical appliances. He has acted as the managing director of the Akester Electromotor and Accumulator Company, Limited, and was the vendor to the Globe Electric Company, Limited, which was formed to acquire his rights in certain patents in electrical appliances that he had brought out. As vendor he was entitled to £5,500 in fully paid shares, and he was also appointed as managing director of the company, no salary being fixed.

Upon the case being called, Mr. Pope, Assistant Receiver, applied for an adjournment. He stated that the debtor was the tenant in tail of the Yorkshire and Staffordshire estates, having succeeded to them on the death of an uncle in 1885. The matters in connection with the estates were very complicated, and he consequently required further time for investigation purposes.

By consent of all parties the examination was adjourned until next November.

Westminster Electric Supply Corporation.

In the Chancery Division of the High Court of Justice on Saturday, August 7th, Mr. Justice Stirling had before him a petition for the reduction of the capital of this company. The capital was £400,000, divided into £500 founders' shares, and £399,500 in ordinary shares, and the object of the petition was to obtain the sanction of the Court to a reduction in the capital, by which the 500 founders' shares were to be surrendered and cancelled. The mode in which this was carried out was by allotting the holders of the founders' shares a certain number of ordinary shares, to be taken and paid for by the holders of the founders' shares at par. Inasmuch as the ordinary shares stand at a large premium in the market, the holders of the founders' shares obtain a very large advantage from the allotment to them of ordinary shares at par, and in consideration of this benefit, they surrendered their founders' shares. Mr. Justice Stirling sanctioned the petition.

National Electric Supply Company.—Reduction of Capital.

In the Chancery Court of Lancashire on Monday last, a petition was presented by Mr. Hughes, on behalf of the National Electric Supply Company, Limited, for the reduction of the capital of the company. The nominal capital of the company was stated to be £100,000, and it was proposed to reduce the shares from £5 to £3 12s. 6d. The reason given for the application was that about £15,000 was not represented by available assets. There was about £1,215 paid away in formation expenses, £7,700 in respect of preliminary expenses, and £5,000 in respect of experimental plant. With regard to the preliminary expenses, Mr. Hughes stated that the company endeavoured to obtain provisional orders for several towns, but they failed in every case with the exception of the town of Preston. In addition to that there was a loss of about £1,000 on the trading. Mr. Hughes further stated that the reduction of the capital of the company would in no way affect the creditors of the company, and the necessary resolutions had been duly passed by the company. Eventually the application was granted.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week Ending Aug. 10th, 1896.	£	s.
Adelaide	43	0
Alexandria	79	0
Amsterdam	285	0
Bankok	84	0
Brussels	84	0
Buenos Ayres	494	0
Calcutta. Teleg. mat. ...	14	0
Cape Town	107	0
Colombo...	195	0
Delagoa Bay	21	0
Durban	273	0
East London	1,281	0
Flushing	20	0
Gothenburg. Teleg. cable	276	0
Laurenco Marques. Teleg mat.	25	0
Madras. Teleg. mat ...	18	0
Malta	50	0
Melbourne	20	0
New York	1,000	0
Port Elizabeth	19	0
Rangoon	33	0
Shanghai	32	0
Singapore	34	0
Stockholm	144	0
Sydney	660	0
Westport	177	0
Yokohama	63	0
„ Sub. cable ...	3,545	0
Total	£9,016	0

Week Ending Aug. 10th, 1897.	£	s.
Aden. Teleg. mat. ...	35	0
Albany	96	0
Alexandria. Teleg. mat.	44	0
Amsterdam	285	0
Antwerp. Electric fuses	295	0
Bangkok	65	0
Bombay	87	0
Buenos Ayres	100	0
„ „ Teleg. mat.	272	0
Cadiz	1,950	0
Calcutta	863	0
„ Elec. fuses ...	18	0
Cape Town	1,092	0
Carthegena	338	0
Christchurch	142	0
Colombo	103	0
Delagoa Bay	142	0
Durban	153	0
Flushing	15	0
Freemantle	35	0
Gothenburg	60	0
Hamburg	29	0
Malaga	200	0
Melbourne	54	0
Otago	150	0
Para. Teleg. mat.	52,500	0
Port Elizabeth	414	0
Rangoon...	37	0
Shanghai	251	0
Stockholm	700	0
Sydney	354	0
„ Teleg. mat. ...	493	0
„ Teleph. mat. ...	54	0
Trinidad	20	0
Vigo. Teleg. mat. ...	206	0
Total	£61,652	0

Foreign Goods Transhipped.

	£	s.
Sydney	145	0
Venice	80	0
Total ...	£225	0

	£	s.
Calcutta	32	0
Colombo. Elec. fittings	353	0
Total	£385	0

Agency.—Messrs. Wilhelm & Co., 11, Westmoreland Buildings, Aldersgate Street, have been appointed sole agents in this country for dynamos and motors manufactured by Fritsche and Pischon. They also supply the reflectors made by the Hard Incandescent Lamp Company.

Agents.—Messrs. Simon, Berry & Co., have been appointed agents for Messrs. Siemens Bros., Limited, for the counties of Lancashire, Yorkshire, and Cheshire, and have opened branch offices and stores at 65, King Street, Manchester.

Auction.—Messrs. Rutley, Son & Vine will sell by auction at 2, Longford Street, Regent's Park, next Tuesday, 1 o'clock, the stock and plant of an electrical engineer.

Carbon Factory.—The new carbon factory at Greenock, belonging to the British Aluminium Company, was formally opened last week.

Change of Name.—The name of Munro's Electrical Manufacturing Company, Limited, Glasgow, has been changed to Holland House Electrical Manufacturing Company, Limited.

Cricket.—Wandsworth *v.* St. Pancras. Teams representing the above electric supply stations played a match at Balham on Saturday, the 7th, which after a closely contested game ended in favour of Wandsworth—52 runs to 42. To-morrow Wandsworth are to meet Shoreditch, at Balham.

Ediswan Fire Brigade.—By the meritorious work done by the Ediswan Fire Brigade at the competitions held under the auspices of the Leyton and Leytonstone Fire Brigade, at Barclay's Park, on August Bank Holiday, their list of honours has been considerably added to. The brigade competed against some of the smartest teams in England. They were first in the turn-out drill, for which they hold an unbeaten record; first in the three men drill; second prize in the two men; third prize in the four men. The winnings consisted of a silver helmet and silver cup for the turn-out drill, six silver medals, the sum of £6, and an aggregate in the form of a beautiful timepiece.

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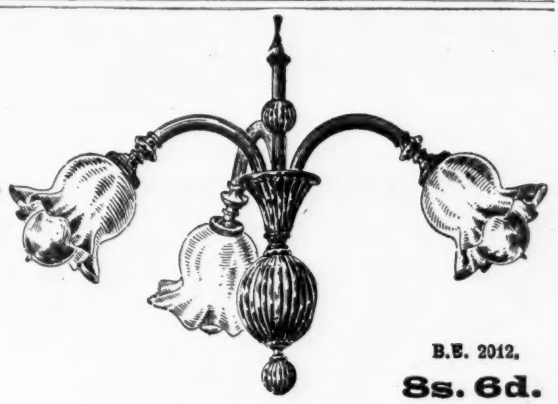

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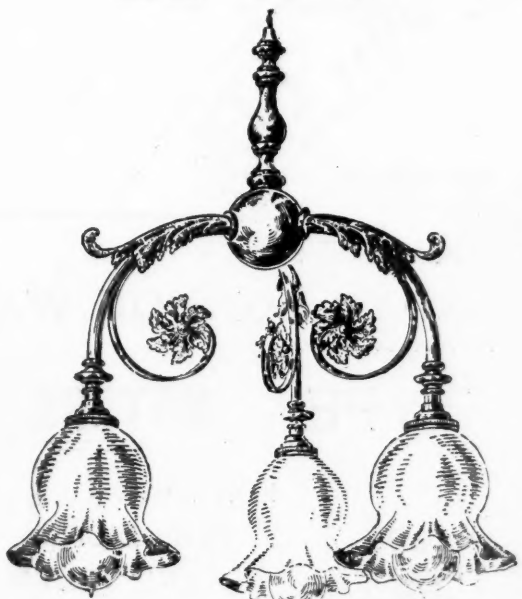

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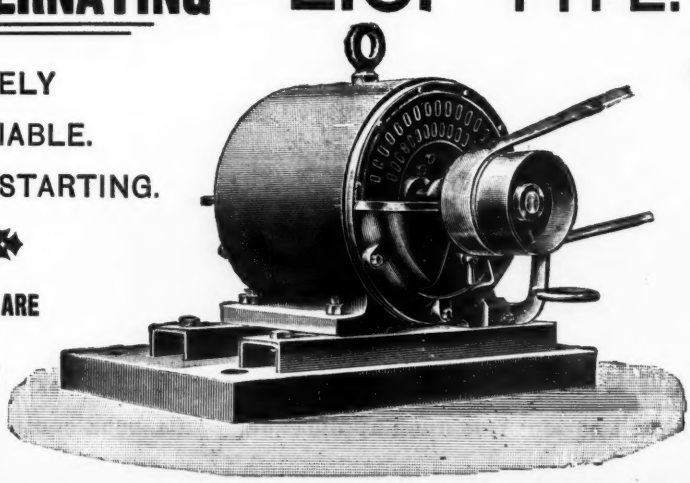

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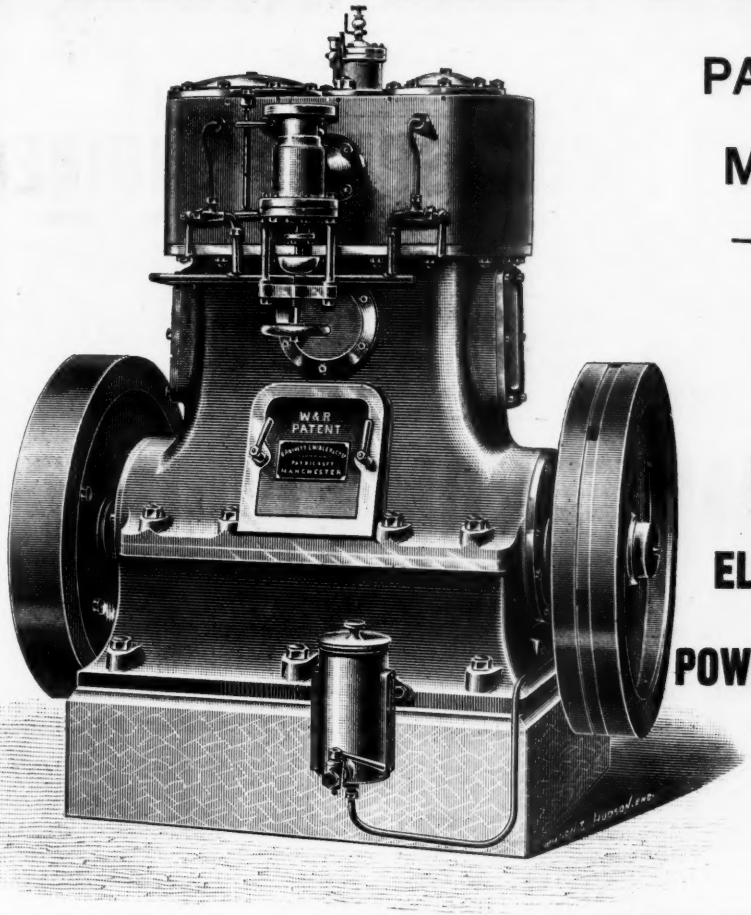

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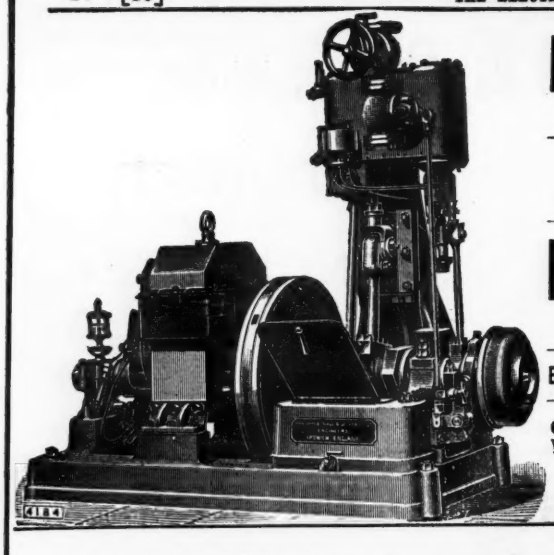

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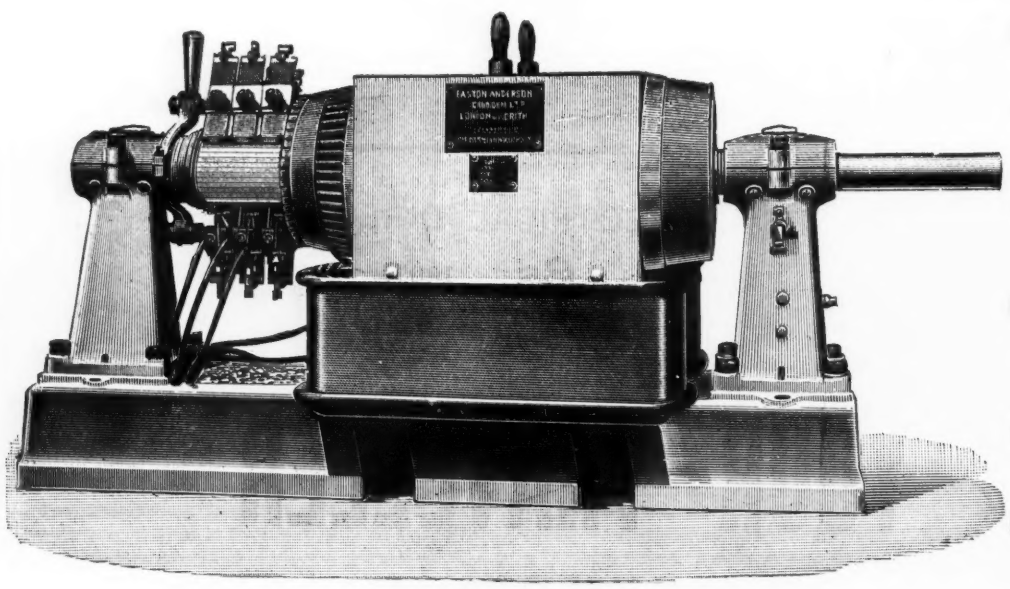

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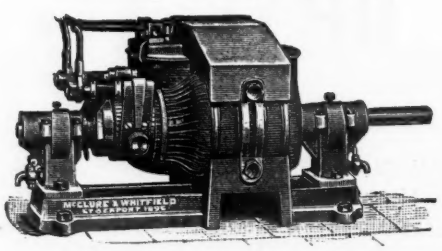

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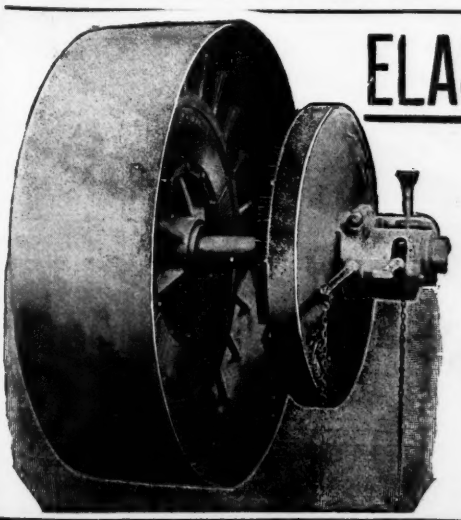

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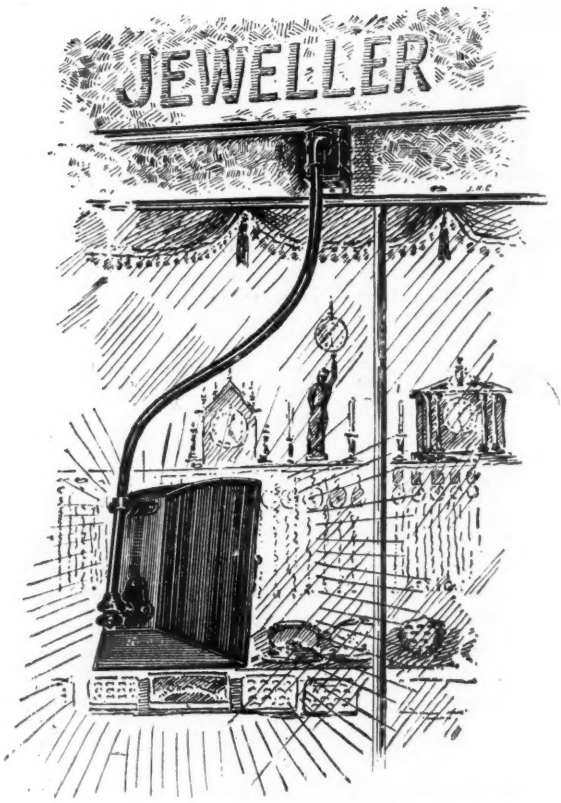

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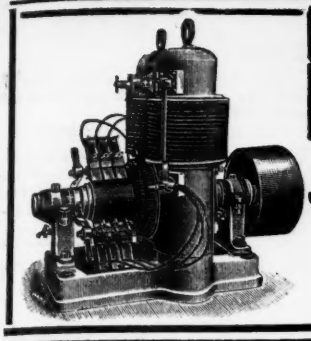

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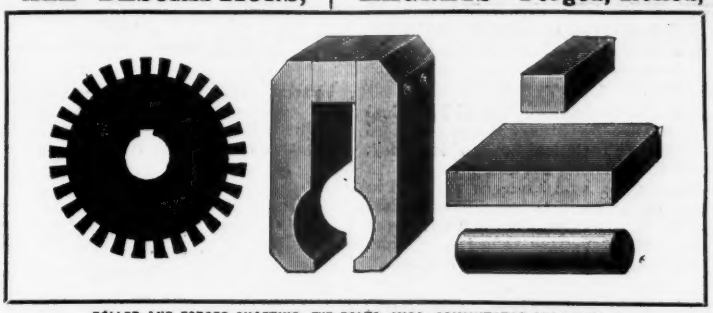

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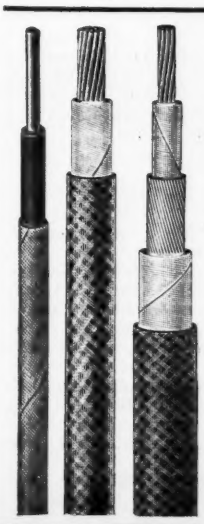

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Official Notices.

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THE CORPORATION OF CARLISLE invite Tenders for the following work in connection with their electric lighting station in Carlisle.

Contract No. 1.—
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Contract No. 3.—
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Contract No. 4.—
Section A.—Switchboard for Dynamos and Feeders.
Section B.—Boosters and Switchboard for Batteries and Boosters.

Contract No. 5.—
Arc Lamps and their Erection.

Contract No. 6.—
Feeders, Mains, and Arc Lamp Leads.

In Contract No. 2, it is a condition that the dynamo makers must have already constructed dynamos of at least 100 units capacity.

Copies of any of the specifications, with forms of tender and general conditions, can be obtained, after Wednesday, the 28th instant, on payment of One Guinea for each (to be returned on receipt by the Corporation of a *bond fide* tender), at the office of Mr. HENRY C. MARKS, City Surveyor, Fisher Street, Carlisle, or Dr. A. B. W. KENNEDY, 17, Victoria Street, Westminster, London, S.W.

The Corporation do not bind themselves to accept the lowest or any tender.

Tenders on the prescribed form, enclosed separately in sealed envelopes, and marked "Electric Lighting," Tender for Contract No. ( ), must be delivered at the Office of the City Surveyor, Carlisle, not later than Thursday, August 19th next.

By order,
A. H. COLLINGWOOD,
Town Clerk.

Town Clerk's Office,
Carlisle, *July 21st*, 1897. 1373

Official Notices.

BOROUGH OF TORQUAY.

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THE TORQUAY TOWN COUNCIL require the services of thoroughly competent persons to fill the following appointments in connection with the generating station and electric lighting installation of the Borough, viz.:—

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(4) Cleaner and Arc Lamp Trimmer.
(5) Jointer for house connections.

Engine Driver and Stoker must have had experience with Willans engines and Babcock boilers respectively.

Applicants must state age, salary or wages required, and give full particulars of experience, and deliver their applications in writing, with copies of testimonials, or references, to the undersigned, not later than noon on MONDAY 16th inst., endorsed "Engineer," or as the case may be.

(Signed)
FRED S. HEX,
Town Clerk.

Town Hall, Torquay,
July 31st, 1897. 1377

BOROUGH OF DERBY.

DERBY CORPORATION ELECTRIC LIGHTING.

THE CORPORATION are prepared to receive tenders for the supply of one alternating current dynamo and engine and for the supply to the present engine of one continuous current dynamo.

Specification, &c., form of tender may be had on deposit of £1 1s. (which will be returned on receipt of a *bona fide* tender), from Mr. J. E. Stewart, Engineer, Electric Lighting Station, Derby, on and after August 7th, 1897.

Tenders endorsed "Electric Lighting Tender for Dynamo, &c.," to be sent to the undersigned not later than 12 noon, AUGUST 30th, 1897.

The lowest or any tender will not necessarily be accepted.

H. F. GADSBY,
Town Clerk.

Town Hall, Derby,
August 3rd, 1897. 1375

WALLASEY ELECTRIC SUPPLY.

TO ELECTRICAL ENGINEERS AND OTHERS.

THE WALLASEY URBAN DISTRICT COUNCIL are prepared to receive tenders for the Supply and Delivery of Alternating Current Transformers. Copies of the specification may be obtained on application to the Engineer, Mr. J. H. CROWTHER, at his office, Great Float, near Birkenhead. Sealed tenders, on the form provided for the purpose, addressed to the Chairman of the Gas, Water, and Electricity Committee, and endorsed "Tender for Transformers," to be left at my office, as below, not later than 4 o'clock in the afternoon, on THURSDAY, AUGUST 19th, 1897. The contractor will be required to enter into a bond, with approved sureties, for the due performance of the contract, which contract and bond will be prepared at the expense of the contractor. The Council do not bind themselves to accept the lowest or any tender.

By Order,
J. J. BURNLEY,
Clerk to the Council (pro tem.)

Public Offices, Church Street,
Egremont, Cheshire, *August 6th*, 1897. 1406

BELFAST HARBOUR.

ELECTRIC LIGHTING.

THE BELFAST HARBOUR COMMISSIONERS are prepared to receive tenders for the supply of the undernoted plant, or of portions thereof (which must be the very best of their respective kinds), in connection with the Extension of the Electric Lighting of the Quays at Belfast Harbour, viz.:—

2 Dynamos.
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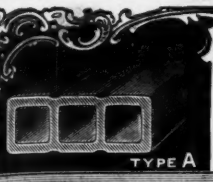
Copies of Outline Specification, Form of Tender, and any further information required, may be obtained from the Harbour Engineer, Mr. G. F. L. GILES, to whose entire satisfaction the plant must be supplied.

Sealed Tenders to be addressed to the SECRETARY to the Belfast Harbour Commissioners, endorsed "Tender for Electric Lighting Plant," and sent in on or before MONDAY, AUGUST 23rd, 1897.

The Commissioners do not bind themselves to accept the lowest or any tender.

W. A. CURRIE,
Secretary.

Harbour Office, Belfast,
August 7th, 1897. 1407



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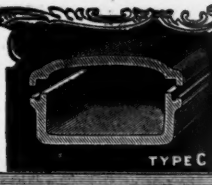

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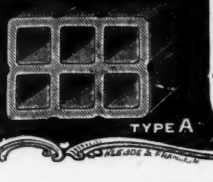

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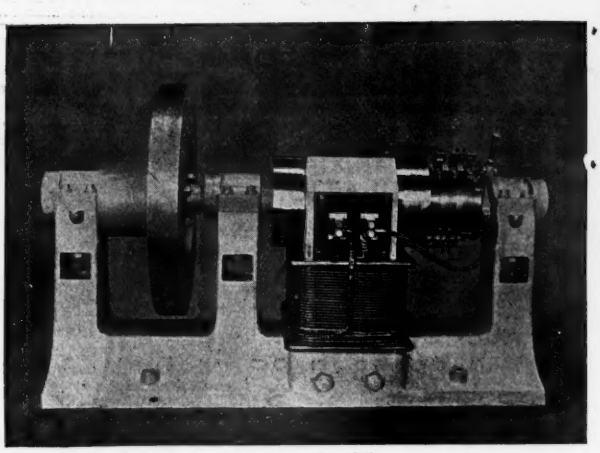

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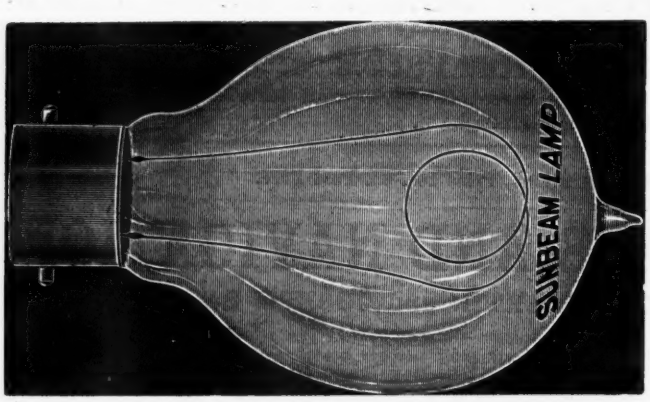

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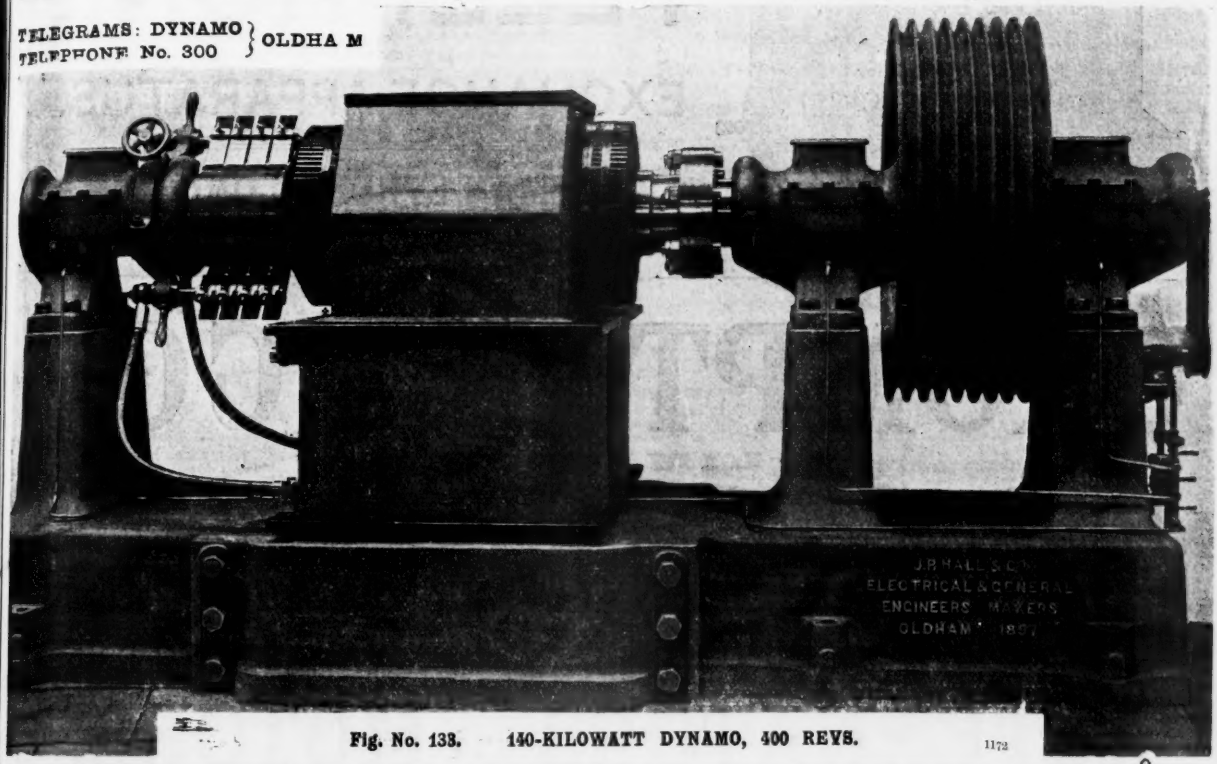

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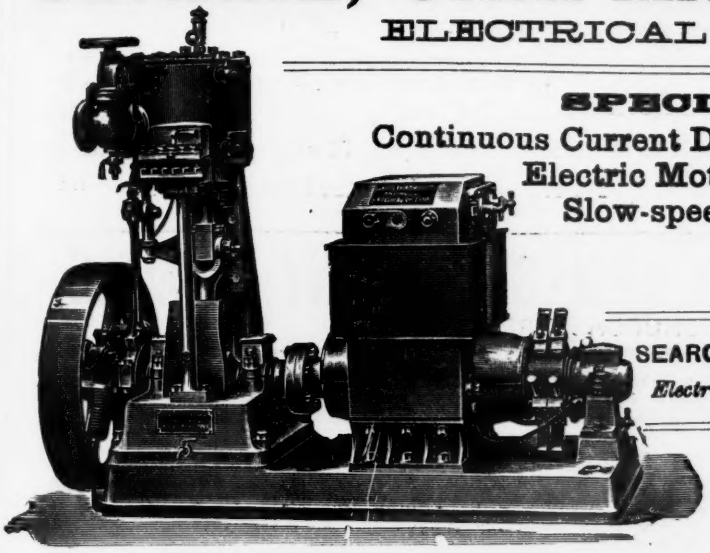

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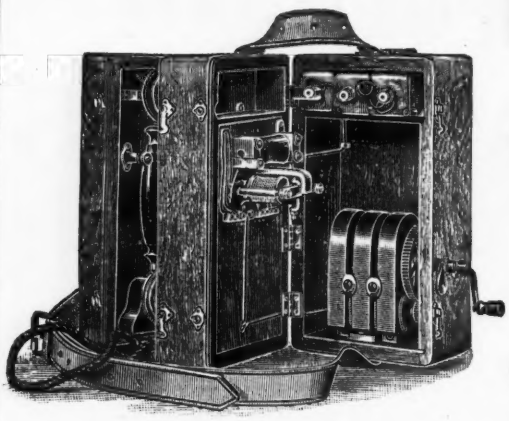

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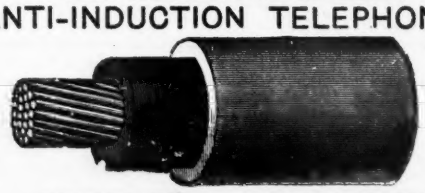

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WORKS, NORTH WOOLWICH. E. 468

Electro-Magnets.—The English Varley Duplex Magnet Company, Limited, has been formed for the wholesale manufacture of electro-magnets, telephone and medical induction coils, bell magnets, gas lighting spark coils, &c., on similar lines to those of the parent company in the United States, which is known as the Varley Duplex Magnet Company, of Jersey City, N.J., of electro-magnets for every known purpose for which a magnet is applicable. Their specialty is the duplex magnet, in which a covered and bare wire are wound simultaneously, thin onion skin or rope fringed paper separating the layers. By this method it is stated that many extra turns are obtained by reason of half of the insulation being dispensed with. The gain in turns per layer is said to be very marked, and, although paper is used between each layer, the complete magnet is smaller than the ordinary wound magnets. The English company has commenced operations at 24, The Strand, Derby, and carries on business exclusively as manufacturers.

Extensions.—Messrs. Russell & Russell inform us that owing to pressure of work, they have been compelled to extend their offices at 49, Victoria Street. The new department will include a show room of electric light fittings for all purposes.

Madrid Exhibition of Spanish Industries, 1897.—The Department of Science and Art has received, through the Foreign Office, a copy of a despatch enclosing a translation of a Royal decree for the holding of an Exhibition of Spanish Industries in the Palace of Arts and Industry, Madrid, this year. The exhibition will be opened on October 20th.

Outing.—The annual beanfast of the workmen of the Chelsea Electricity Supply Company took place on Saturday last at the "Abercrombie," Queen Street, Arundel, Sussex. The chair was taken by Mr. G. Cranham, treasurer, who in suitable terms proposed the continued prosperity of the company, coupling with the toast the names of those on the engineering staff. He said that the fact was well known that the company were extending their mains to all the important parts of Chelsea, and owing to the great demand they had found it necessary to add to the number of sub-stations. The company, which had been in existence 10 years, now had some 1,200 customers, and a new central station was under construction in Alpha Place. Other toasts were drunk with enthusiasm.

Personal.—Mr. F. T. Eggers has ceased to be Managing Director and Secretary of the Electrical Company, Limited; Mr. Otto Lœwi and Mr. Jacob Stottner having been appointed joint managers, and Mr. O. Lœwi secretary.

South African Notes.—We cull the following news from the *British and South African Export Gazette*:—

An electrical pumping plant is now being erected at the Consolidated Main Reef mine. The plant will include a 40-kw. generator, a station pump, a sinking pump, and two 15-H.P. motors.

The electric installation at the May Consolidated mine is now complete.

A 50-H.P. dynamo is under order for the Nourse Deep mine.

A generating plant, consisting of two 85-kw. three-phase generators, has been supplied to the Rietfontein A gold mine by Messrs. Brown, Boveri & Co., Baden, Switzerlnd. These generators will supply three motors of 85, 65 and 25-B.H.P. respectively, with current at 1,100 volts pressure and a periodicity of 50 cycles per second, for the several purposes of milling, lighting, and driving the pumps and lathe in the cyanide works.

The Town Council of Cradock, Cape Colony, have in contemplation the installation of the electric light in the town, and orders for electric fittings, &c., will shortly be given out.

By a recent enactment of the Cape Parliament, a sum of £5,000 is to be expended in the electric lighting of the Cape Houses of Parliament.

An electric lighting installation will, we are informed, shortly be ordered for an additional wing to the Kimberley Public Library, Mr. Rhodes having given £2,000 towards the general scheme.

The Town Council of Port Elizabeth, Cape Colony, are prepared to receive tenders for lighting the streets and municipal buildings of Port Elizabeth by electricity in consideration of the grant of a concession for the exclusive right of supplying electric current through the streets and roads of the town, to private houses, stores, &c., for terms of 5, 15, 20, 25, or 30 years respectively. There are, approximately, about 54 miles of streets in the town, which is at present lighted by 380 gas lamps of reputed 16 candle-power. The municipal buildings consist of Town Hall, Municipal Offices, Morning Market, Feather Market, Wool Market, and Museum. The main streets are to be lighted by arc lamps, and the side streets and municipal buildings by incandescent lamps. The tenderers must state at what sum per annum they are prepared to adequately light the streets and municipal buildings for the various periods mentioned above, if they are granted a concession for any one of the periods referred to. Tenders should be delivered to the Agents of the Municipality, Messrs. Davis & Soper, 54, St. Mary Axe, London, E.C., on or before September 21st.

The Natal Government estimates for the next financial year include an item of £800 for a battery, instruments, and other telegraphic material.

By a recent vote of the Cape Parliament, a sum of £2,695 is to be devoted to the increase of the telegraph wiring of sundry stations on the Cape Government railways.

By the decision of the Government of the South African Republic to connect Amersfoort with Pretoria by telegraph, and to erect a telegraph station in the former place, the opportunity for tendering for the needed telegraphic plant is afforded.

A sum of £3,000 is set down in the Natal Government estimates for the ensuing financial year for the acquisition of a new switchboard and for other improvements to the State telephone system.

Roger Dawson, Limited.—A general meeting of the members of this company will be held at 3 and 4, Lincoln's Inn Fields, W.C., of Mr. E. F. Hick, the solicitor of the company, on Thursday, September 23rd, at 1 o'clock in the afternoon, for the purpose of having an account laid before the company showing the manner in which the winding up has been conducted and the property of the company disposed of, and of hearing any explanation that may be given by the liquidator (H. B. Johnson).

The Crystal Electric Lamp Company, Limited.—At an extraordinary general meeting of this company held on August 3rd, resolutions to the effect that the company be wound up and Mr. Horace Stanley Deacon, of St. Stephen's Chambers, Telegraph Street, E.C., be appointed liquidator, were confirmed.

The Electric Lighting of Ballrooms.—The lighting at the Marchioness of Bute's Ball, given at Cardiff last week, was a great feature. Light equivalent to 4,000 8-C.P. was used, and this was arranged by Messrs. Clay Bros. in three weeks.

The Epstein Electric Accumulator Company, Limited.—Mr. P. W. Northey has been appointed receiver and manager of this company, with a view to reconstruction.

The National Electric Free Wiring Company, Limited.—The directors have appointed Mr. B. H. Jenkinson, formerly with Messrs. Crompton & Co., Limited, to the position of engineer and works manager. Mr. H. J. Nisbett is now district manager of the Blackpool centre, and the secretary is Mr. Percy B. Wilson.

ELECTRIC LIGHTING NOTES.

Accrington.—It is said that the Town Council is about to invite tenders for the erection of a central station and plant for electric lighting, for which the Local Government Board have sanctioned an expenditure of £10,000.

Aberystwyth.—The electric light has been installed in every room of the new Hotel Cambria. The work, which has several special features, has been carried out by Mr. E. E. Putland, A.I.E.E., who is also the manager and engineer to the local supply company. The Queen's and the Waterloo Hotels have also recently had a large number of lights installed in their public and private rooms.

Belfast Harbour Lighting.—It will be seen from our Official Notices that the Harbour Board has determined to light the Dufferin and Salisbury Docks districts.

Bexhill.—The Bexhill provisional order has been passed by the Chairman of Ways and Means.

Birkenhead.—A Local Government Board inquiry has been held with reference to an application of the Corporation to borrow £20,000 for electric lighting.

Burnley.—The Town Council has decided to borrow £25,000 for the enlargement of the electricity works.

Cannock.—A special meeting of the District Council is to be held to consider the question of applying for a provisional order.

Cardiff.—A resolution brought before the County Council to increase the salary of Mr. Appelbee, the electrical engineer, from £200 to £300, has been carried by a large majority.

Chesterton.—An electric lighting scheme, involving an expenditure of £6,800, has been submitted to the Council.

Colne.—The Town Council are inclined to apply for a provisional lighting order.

Electric Lighting in Italy.—Good progress is being made with the establishment of a central station at Ebola. It has also been decided to light the public streets of Albengabz by electricity.

Electric Lighting in Germany.—It is proposed to establish a central station at Altera for electric lighting and power purposes. Additional plant is also about to be put down at the central station at Rendsburg.

Electric Lighting in France.—A 45 years' concession has just been granted for the electric lighting of the little town of Miribel.

Electrical Engineering in Germany.—Messrs. Brown, Boveri & Co., of Baden, Switzerland, are at work on the erection of a large central station at Bingen, to furnish the necessary electrical energy for the lighting of that town, and also for the operation of an electric tramway between Bingen and Kreuznach.

Gateshead-on-Tyne.—The Imperial Electric Light and Power Company have notified the Town Council of their intention to apply for a provisional order.

Glastonbury.—The necessary steps are to be taken by the Town Council to keep the matter of electric lighting in their own hands.

Dewsbury.—The Lighting Committee recently reported that there has been an increase in the demand for electricity.

Dundee.—The Corporation electricity receipts for the past three months amount to £811, an increase of £124.

Godalming.—At the quarterly meeting of the Godalming Town Council on Thursday night (August 5th) the Electric Lighting Special Committee presented a report in which they embodied a report from Messrs. Kincaid, Waller, & Manville as to the proposed establishment of a municipal electric generating station at Godalming. They had obtained an estimate for a low tension continuous current system, which Messrs. Fowler put down at £11,180; and this capital expenditure was calculated to produce a net profit of £616 per annum.

Hampstead.—It has been decided by the Vestry to adopt the Wright indicator system of charging.

Harrogate. — The question of spending £16,500 on extending the Corporation lighting system is being considered.

Hartlepool.—The Town Council has decided to spend £30,000 on an electric lighting and dust destruction scheme.

Islington.—The London County Council have sanctioned the Vestry borrowing £40,500 and £7,000 for electricity work, repayable in 40 years at £2 17s. 6d. per cent.

Larne.—The Town Commissioners have decided to take the necessary steps to obtain powers for the supply of electricity.

Lighting of Edgware Road.—The Marylebone Vestry has decided to co-operate with the Paddington Vestry for the lighting of Edgware Road.

Lincoln.—Contracts have been accepted for the various parts of the electric lighting plant.

Liverpool.—Major-General Crozier, of the Local Government Board, held an enquiry on Wednesday into the proposal of the Corporation to borrow £100,000 for electric lighting purposes.

Lowestoft.—Two companies, the Great Western Electric Light and Power Company, and the Imperial Electric Light and Power Company, have given notice of their intention to apply for provisional orders.

Margate.—A special meeting of the Margate Town Council was held on Friday to consider the Committee's report as to electric lighting and the Isle of Thanet Light Railway (Electric) scheme. The directors of the Isle of Thanet Gas Company wrote that they had taken the advice of the leading electrical engineers and were now able to state that should the powers under the Provisional Order be transferred to the Gas Company, they would propose to supply electricity at 6½d. per unit for private lighting and 5½d. for the street lighting, and the directors will also be prepared to allow the Corporation one-eighth share of the clear profits after charging all proper expenses for the production, supply, maintenance, and depreciation. The engineers consulted were Sir F. Bramwell, Bart., and his partner Mr. Graham Harris. The Isle of Thanet Light Railway (Electric) Company offered to take over the Provisional Order and supply electricity for public lighting at 2½d. per unit and at 6½d. per unit for private lighting. It was resolved to accept the latter offer, subject, of course, to an agreement being drawn up containing certain conditions as to terms.

New Brompton.—The directors of the Chatham, Rochester and District Electric Lighting Company are completing their preparations for launching their enterprise in New Brompton, and in a very few days they will be ready to supply electric light and energy throughout the neighbourhood. The new works are well built and splendidly equipped, and with the sanction of the Urban District Council the directors propose illuminating the public streets with the electric light for a few weeks free of expense.

Newport.—Mr. J. T. Marsh held an inquiry at Newport last week, on behalf of the Local Government Board, into an application for permission to borrow £31,000, for the purpose of the extension of the electric lighting of the town. The Town Clerk informed the inspector that in 1893 an application was made to borrow £28,000, which was sanctioned. The electric light works were opened in October, 1895. Further money was required, and an application to borrow £11,000 was sanctioned. The gross profits of the undertaking to June, 1896, amounted to £224, but there were certain financial liabilities which made this a deficit of £1,410. Up to March, 1897, there was a gross profit of £864, but the obligations for repayment of loans, &c., turned it into a debit of £962. There was every reason to expect a large increase in the demand for electric light, and the Corporation want funds to carry out additional works. Mr. R. Hammond, the consulting engineer, having given evidence with reference to the details, the Inspector said he would view the works and report to the Local Government Board.

The Chairman of the Newport Gas Company declared, at a meeting of the company, he had no fear of electricity as a competing illuminant, for incandescent gas lights were getting more popular. In his opinion it was impossible to produce electricity at a price to compete with gas at the Newport price. We shall see.

Perth.—The Electricity Committee are to meet a representative of Messrs. Edmundsons on the subject of an installation.

Poços de Caldas.—Messrs. Arens Bros., of Rio, have signed a contract for lighting this place by electricity.

Southampton.—A report recently presented by the Electric Lighting Committee shows that considerable progress is being made with the new electricity works.

Stockton.—As only 12 months of the last extension of the Board of Trade order now remains, the Corporation have decided to go into the question of electric lighting, and the gas manager has been instructed to prepare a report.

Warrington.—A special meeting of the Town Council is to be held on September 7th to consider the question of applying for a provisional order.

York.—The question of a dust destructor is said to be postponed, "inasmuch as it was not improbable that the electric lighting of the city and the provision of a destructor might be more or less bound up together."

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Airdrie.—Negotiations on the subject of electric tramways between Airdrie and Coatbridge are pending between the Town Council and firms of contractors.

Bristol.—The Sanitary Committee recommend the Corporation to oppose the application of the Tramway Company to construct a light railway from Cloud's Hill to Hanham.

Broadstairs.—The District Council have again had the matter of the Isle of Thanet Electric Railways before them, and terms have been practically arranged with the company promoting the scheme.

Cardiff.—Mr. John Keith has been appointed temporary assistant to the Borough Engineer to prepare Parliamentary plans for 12 miles of electric street tramways.

Coventry.—Additional cars have been placed on the Coventry lines with the result that a ten minutes service is now in vogue.

Electric Traction in Germany.—The Cassel Tramways Company has obtained official permission to convert its horse tramways into electric lines.

Electric Traction in Austria.—An electric tramway has just been completed and opened for traffic in the town of Czernowitz.

Electric Haulage on French Canals.—La Societé de Traction Electrique de Bateaux sur le Canal d'Aire et la Drule avec Extension jusqû'à l'Escaut, is the somewhat long but explanatory title of a company which has just been formed at Douai, with a capital of £68,000.

Electric Traction in Hungary.—A proposal to construct an electric railway between Debreezin and Nagyvarad is at present under consideration. The line would be no less than 60 kilometres long.

Electricity in Clayworks.—It is said that Messrs. Veale & Co., of St. Austell, are about to introduce electrical driving in the Truro clayworks.

Liverpool.—The recommendations of the tramway company to equip an experimental line for electrical working, particulars of which were given in our last issue, have been adopted by the City Council.

Look After the Motor Man.—A paragraph taken from an article by Mr. Walter Munroe, in the *American Electrician*, is worth bearing in mind:—"The road which provides a careful method of training and looking after its motor men and has a methodical system of inspecting its entire apparatus will find that it has saved a considerable amount in its operating expenses."

Manchester.—The Special Committee of the Manchester Corporation appointed to consider the working of the tramways has passed a resolution recommending that when any change takes place in the motive power electricity shall be adopted, the supply to be obtained from the Corporation electricity works. The resolution is intended to take effect whether the tramways remain in the hands of the Tramway Company or are taken over by the Corporation.

Operation of Bridges by Electricity.—The River Weaver Trustees are carrying out improvements on the river Weaver which include two swing bridges to be operated by electricity.

Seaforth.—The Tramway Committee has recommended the District Council to wait further developments in electric traction. The Committee has, however, been instructed to obtain further information on the subject.

Stockton.—The Tramways Committee of the Corporation have resolved to inspect the electric tramways at Leeds, with a view to their introduction into Stockton.

Sheffield.—The Corporation have resolved to commence the conversion of the tramway system into an electrical one, and to extend the system. The following firms have been asked to revise and amplify their tenders according to particulars to be supplied by the City Surveyor:—The British Thomson-Houston Company, Messrs. Siemens Bros., Messrs. Dick, Kerr & Co., and Messrs. Davy Bros., Limited.

South Staffordshire Tramways.—The British Electric Traction Company have taken over the agreement made by the Electric Construction Company with the South Staffordshire Tramways Company for the electrical equipment and working of these tramways.

The Work of Traction.—Some interesting tests, says *Engineering*, have recently been undertaken in France with regard to the power required for the propulsion of vehicles, fitted with ordinary iron rims and pneumatic-tyred wheels, and the results showed a marked all-round advantage by the pneumatic wheels. A Table of the pull required, reduced to kilogrammes, shows the results with different roads and different loads:—

	Iron rims. Kilog.	Pneumatic tyres. Kilog.
Snow.		
Empty vehicle, walking	17·86	11·45
" " trotting	29·60	15 27
150-kilogramme load, walking	17 83	12 71
" trotting	31·17	17·96
Wet Roads.		
Empty vehicle, walking	16·00	10·50
" " trotting	19·55	12·97
150-kilogramme load, walking	17·30	12·43
" trotting	23·00	14·16
New and Dusty Road		
Empty vehicle, walking	17·42	14·05
" " trotting	20·41	15·95
300-kilogramme load, walking	20·75	19·14
" trotting	29·70	16·40

Experiments were also made with various pressures in the tyres—3 and 4½ atmospheres—but there did not seem to be much difference between the two.

Neath Tramways.—A special meeting of the Neath Town Council was held on Monday to receive the report of the tramways company respecting the leasing of the tramway undertaking. The Town Clerk read the report, which showed that there had been three tenders: Mr. Matthew Whittington, of Neath; the British Gas Traction Company, Limited, and the British Electric Traction Company, Limited. All the tenders were based upon the assumption that the permanent way would be repaired by the Corporation, and that the latter would also be responsible for keeping the lines in proper repair. Mr. Whittington offered to work the line (by horse power) on a lease of 14 or 21 years at £100 per annum. The British Gas Traction Company, Limited, offered to take a lease of seven years, to be extended for a further period of seven or 14 years, provide gas motor cars and a suitable service, and pay an annual rental of £1,300. The tender of the British Electric Traction Company, Limited, was very intricate, and although they offered £1,700 per annum, yet there was a proviso that at the end of the 21 years' lease the Corporation should purchase the plant of the company at proper valuation, and this was considered objectionable. The committee recommended the adoption of the British Gas Company's tender, and this the Council confirmed.

The Van Depoele Patent.—The United States Circuit Court of Appeal has given a decision which sets aside the Van Depoele fundamental claims to the invention of the overhead trolley, though the patent had been previously upheld in other courts.

TELEGRAPH AND TELEPHONE NOTES.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	April 6th, 1893 ...	...
West Indies—		
St. Croix-Trinidad ...	Nov. 30th, 1896 ...	...
Cayenne-Pinheiro (Brazil)	July 22nd, 1897 ...	...
Amazon Company's cable—		
Parintins-Itacatiara ...	May 5th, 1896 ...	...
Obidos-Parintins ...	Dec. 7th, 1896 ...	...
Zanzibar-Mombassa	July 13th, 1897 ...	...
Cyprus-Latakia	July 23rd, 1897 ...	...
Aden-Zanzibar	July 28th, 1897 ...	...
Capetown-Mossamedes ...	Aug. 7th, 1897 ...	Aug. 10th, 1897.
Landlines.		
Trans-Continental line beyond Mazol	March 12th, 1896 ...	...
Carthagena - Barranquilla (Columbia)	July 4th, 1896 ...	...
Siberian landlines—		
Omsk-Tomsk	Aug. 2nd, 1897 ...	Aug. 5th, 1897.
Werkne-Oudinsk-Tchita	Aug. 7th, 1897 ...	Aug. 9th, 1897.
Tschita-Kaidalowo (all lines).	Aug. 9th, 1897 ...	...

April 19th, 1897.—Chio-Syra route impracticable.

April 19th, 1897.—During war between Turkey and Greece, cable between Trieste and Corfu cannot be used for messages for Turkey; they must be sent *vid* Bosnia, Montenegro and Servia.

The Ottoman Government announces that messages in secret language may not be sent to the Greek Minister and Consul in Turkey. They are to be sent in plain language.

April 21st, 1897.—The Greek Administration prohibits secret language for private telegrams for Greece.

April 25th, 1897.—The Hellenic Administration notifies delay on press messages emanating from Greek provinces by reason of the lines being blocked.

April 26th, 1897.—The Ottoman Administration notifies that, until further notice, private telegrams for Crete must be written only in plain Turkish or French language.

August 5th.—Eastern Company announce owing to interruption of East Coast route, messages for South Africa are subject to serious delay.

August 7th.—Communication with South and East Africa temporarily interrupted by both routes.

August 10th.—Eastern Company announce that traffic for South and East Africa is still subject to serious delay.

The Administration of the Argentine Republic announces the reopening to international service of the office of the Compania Telegrafica Del Rio de la Plata, at Buenos Ayres.

Bideford.—A telephone exchange is to be established for Bideford, Torrington and Barnstaple.

Submarine Telegraph Contract (Bermuda and Jamaica).—Mr. Hanbury moved in the House of Commons, yesterday week, that the contract dated August 2nd, 1897, entered into with the Halifax and Bermudas Cable Company for the construction, laying, and maintenance of a submarine cable between Bermuda and Jamaica be approved. The resolution was agreed to.

The New Pacific Cable.—A Reuter's telegram from Vancouver published in the daily press says that the Right Hon. G. H. Reid, Premier of New South Wales, who is on his way back from London to Australia, in the course of an interview said that the hitch in the negotiations for a Pacific cable was caused by Canada, who had made no definite proposal as to what she was ready to do. New South Wales, Queensland, and New Zealand, said Mr. Reid, were ready, and Victoria would probably come in, but until Canada had made a definite proposal Great Britian would not act in the matter. Unless Canada acted promptly the scheme would drop, and the alternate scheme *via* Cape Colony would be adopted.

Telegraph Repairs.—An announcement is made by the Western and Brazilian Telegraph Company, Limited, that the cables of the River Plate Telegraph Company, Limited, between Monte Video and Buenos Ayres, which have been closed by order of the Argentine Government for some months past, were yesterday reopened for all classes of traffic. We have commented upon this subject at various times, and we think if the Argentine Government has secured the observance of the Convention rules and regulations as they are laid down, they will have done good work.

Telephonic Commmunication in Germany.—Telephonic communication has just been made available between Berlin, on the one hand, and Ruhrort Mulheim, Werden, Gelsenkuctien and Witten, on the other.

The Telegraph Wire Export Trade.—A very satisfactory revival took place last month in the export trade of this country in telegraph wire and apparatus connected therewith, July not having only proved to have been one of the most active months of the present year, but considerably brisker than the same period of the two preceding years. To give the figures, we find that the exports during July amounted in value to £136,547, as compared with £88,340 in the preceding month, and only £53,139 in July, 1896. So far as the year has gone, it compares very favourably with both 1896 and 1895, the home exports for the seven months having reached a total of £607,272, as against £396,402 and £308,681 in the respective periods of the two preceding years.

CONTRACTS OPEN AND CLOSED.

OPEN.

Belfast Harbour.—August 23rd. The Harbour Commissioners are prepared to receive tenders for the supply of 2 dynamos, 1 switchboard, 100 arc lamps, 100 tubular masts, 100 isolating switches, mains and junction boxes, or portions thereof. Tenders to be addressed to Secretary to the Belfast Harbour commissioners. See our "Official Notices."

Brighton.—August 16th. The Council invite tenders for the supply and erection of a complete double-tube surface-condensing plant and water cooling towers, capable of dealing with 40,000 lbs. of steam per hour. Specifications and forms of tender may be obtained on application to the Town Clerk at the Town Hall on payment of one guinea.

Carlisle.—August 19th. The Corporation want tenders for boilers, mechanical stokers, dynamos, storage battery, switchboard, boosters, arc lamps, feeders, mains, &c., for the electric lighting undertaking.

Derby.—August 30th. The Corporation want tenders for the supply of one alternating current dynamo and engine, also a continuous current dynamo for the present engine. Electrical engineer, Mr. J. E. Stewart. See our "Official Notices."

Ludlow.—September 1st. The Corporation of Ludlow offers a prize of £20 for the best and most economical scheme of electric lighting for the borough. Town Clerk, Mr. John Herbert Williams. Should the Corporation employ the engineer whose scheme is awarded the prize to carry the work out, then the £20 will merge in commission.

Port Elizabeth.—September 21st. The Town Council invite tenders for lighting the streets and municipal buildings of Port Elizabeth by electricity in consideration of the grant of a concession for the exclusive right of supplying electric current through the streets and roads of the town to private houses, stores, &c., for terms of 5, 15, 20, 25 or 30 years respectively.

Roumania.—August 20th. Tenders are being invited by the General Direction of the Roumanian Posts and Telegraphs in Bucharest for the supply of 55,000 porcelain (double-bell) insulators. Tenders to be directed to the Direction Générale des Postes et des Telegraphes, Bucharest.

Russia.—November 1st. The Municipal Authorities of Novorossisk, South Russia, are inviting tenders for the concession for the construction and working of an electric tramway and for the electric lighting of the town.

Sofia.—September 22nd. The Secretary of State for Foreign Affairs has received a despatch from the Acting British Consul-General at Sofia, stating that the municipality of that town invite tenders for—(1) The supply of electric current to light the streets as well as public and private buildings in the town and the supply of electric power; and (2) The construction and working of electric tramways in the town and suburbs. Tenders will be received at the offices of the municipality of Sofia. Such further particulars as have been received may be seen at the Commercial Department of the Foreign Office any day between the hours of 11 a.m. and 6 p.m.

Spain.—The Municipal Authorities of Pedralva (Valencia province) are at present inviting tenders for the concession for the electric lighting of the town during a period of ten years. Tenders to be sent to El Secretario del Ayuntamiento de Pedralva (Valencia.)

Switzerland. — September 25th. Tenders are being invited by the Municipal Authorities of Lausanne for the concession for the establishment and working of a central electricity supply station in the town. Tenders to be sent to, and particulars may be obtained from, Le Conseil Municipal de Lausanne.

Wallasey.—August 19th. The Wallasey Urban District Council are prepared to receive tenders for the supply and delivery of alternating current transformers. Tenders to be addressed to Chairman of the Gas, Water and Electricity Committee, Church Street, Egremont. See our "Official Notices."

CLOSED.

Germany.—Messrs. Korting Bros., of Hanover, have just secured a contract for the construction of a central electric lighting station at Clausthal.

Lincoln.—The following tenders have been accepted by the Corporation for the supply of plant, &c., for lighting the town by electricity:—

Boilers—Ruston Proctor	£850
Engines, dynamos, pumps, motors and cranes—Laurence, Scott & Co.	4,171
Economiser—Green & Son	156
Storage batteries—Chloride Storage Syndicate	810
Switchboard—Nalder & Hilton	737
Cables—Callenders Cable Co.	2,108
Ironwork—W. Foster & Co.	508
Chimney—H. S. & W. Close	1,175
Buildings—W. Wright & Sons	8,772

NOTES.

The Institution Fire Rules.—The general rules for wiring recommended by the Institution of Electrical Engineers have just been issued.

Proposed National Physical Laboratory. — The Treasury have appointed a Committee to consider and report upon the desirability of establishing a National Physical Laboratory for the testing and verification of instruments for physical investigations, for the construction and preservation of standards of measurement, and for the systematic determination of physical constants and numerical data useful for scientific and industrial purposes; and to report whether the work of such an institution, if established, could be associated with any testing or standardising work already performed wholly or partly at the public cost. The following will be the members of the Committee:—Lord Rayleigh (Chairman), Sir Courtenay Boyle, Sir Andrew Noble, Sir John Wolfe Barry, Mr. W. C. Roberts Austen, Mr. Robert Chalmers (of the Treasury), Mr. A. W. Rücker, Mr. Alexander Siemens, and Mr. T. E. Thorpe.

British Association.—The Recorder, Prof. T. Hudson Beare, of the University College, London, sends us a copy of the following probable programme of Section G., Mechanical Sciences, of the Toronto meeting, August 18th—25th:—

Thursday, August 19th.

Address of President. G. F. Deacon, M.Inst.C.E.
Soulanges Canal. T. Munro (Toronto).
Hydraulic Appliances of McGill University. Prof. Bovey (Montreal).

Friday, August 20th.

Tests on Triple Expansion Engine at Massachusetts Institute of Technology. Prof. Peabody (Boston).
Rate of Condensation of Steam on a Metal Surface. Profs. Callendar and Nicholson (Montreal).
Strength of Columns. Prof. Lanza (Boston).
Experimental Investigation into position of Neutral Surface of a beam bent beyond the Elastic Limit. Prof. Bovey (Montreal).
Canadian Longitude Determination. Prof. McLeod (Toronto).

Saturday, August 21st.

Visit to Niagara Power Works.

Monday, August 23rd.

Pacific Cable. Prof. Ayrton.
Development of Traction Electric Plant. C. T. Hutchinson.
A new method of measuring Hysteresis in Iron. J. L. W. Gill.
General Discussion on Electric Power Plants.

Tuesday, August 24th.

Telegraphy without Wires? W. H. Preece. (Title not certain.)
Tendencies of Electric Tramway Systems in England. J. Waldridy.
Montreal Electric Tramways. G. C. Cunningham.
General discussions on Electric Traction.

Wednesday, August 25th.

Armour for Ships of War. Capt. Orde Browne.
Roller Bearings. W. B. Marshall. &c.

A Large Waterfall.—A special dispatch from St. Paul, Minn., says that the following letter has been received from S. A. Thompson, at Santa Catalina, Venezuela:—"During the exploration of the concession of the Orinoco Company, headed by Donald Grant and other Minnesota men, a trail was cut to the Imataca Mountains, starting from this point, a village of 150 inhabitants. The duties assigned to some members of the party kept them upon or close to the Orinoco until a few weeks ago, when two of us, Leslie O. Dart, of Litchfield, Minn., and myself, of Duluth, found time to make an excursion to the mountains. Pushing on beyond the point reached by the other party, we heard from the top of a mountain a sound which at first we thought to be thunder, but afterwards decided that it must come from a waterfall of considerable magnitude. Working in the general direction of the sound over a difficult trail, we came, at noon on Thursday, October 15th, to a large river, and discovered what must rank as one of the greatest waterfalls in the world. The river bursts diagonally through an almost perpendicular cliff, which I estimate to be 1,600 feet in height, breaks into half a dozen separate streams, which divide and subdivide, spread out into broad, fanlike expansions, and twist about in such a curious, corkscrew fashion, that the water at the bottom of the falls flows in exactly the opposite direction from the course it holds where it first comes into view. By clinging to bushes and going up the giant creepers hand over hand, we climbed up the cliff until the aneroid indicated an elevation of more than 500 feet, but it was impossible to reach the top and learn how much higher the falls are."—*Scientific American.*

The "Exiles" of Portheurnow.—"When the inhabitants of that little colony of telegraphists and students at Portheurnow do anything, they always contrive to do it well." So says the *Cornish Telegraph*, and it appears that in promoting a Bank Holiday *fête* for the purpose of raising funds for the renovation of St. Levan Parish Church, the telegraphic colony has not permitted its reputation to suffer. There were stalls for fancy work, sweets and all manner of things, exhibitions of electrical instruments, and all the other devices that are useful on these occasions for raising funds.

Willard Storage Battery Launches.—Among the recent work done by the Willard Electric and Battery Company, of Cleveland, is the installation of a complete storage battery outfit in two launches used by the W. F. and John Barnes Company, of Rockford, Ill. The launches are 30 feet long, 6 feet beam, and draw 22 inches of water, with 40 Willard type "G9" cells. These launches are capable of attaining a speed of 14 miles an hour. The motor, connected directly to the propeller shaft, is easily accessible, and takes up very little space. The launches have been in operation for the past three months and are giving excellent satisfaction. The Willard Company have fitted out quite a large number of electric launches. The Willard storage cells are stated to possess unusual qualities for this class of work, owing to their peculiar construction. The elements are so encased that the rolling motion of the boat does not interfere in any way with their operation.

British Trade Abroad.—Mr. H. de Burgh Daly, British Vice-Consul at Bordighere, writes to the *Morning Post* as follows:—"You recently commented with approval on a suggestion made by me, in the course of an official report, for the establishment of a Central Bureau of Information and Advice under the auspices of the Chambers of Commerce, I shall be glad if you can allow me space to state the following incident, which has lately come to my knowledge, and which seems to suggest another of the many fields of usefulness which might be filled by such a bureau. When the English electricians, whose experiences in Italy I have already quoted, obtained powers to light certain communes, the fact was duly notified in the Italian newspapers. Very soon after this notification they received a letter from the Italian office of a large German firm, tendering for machinery, &c. A complete scheme for the electric lighting was suggested and worked out, accompanied by specifications and explanations, the whole being type-written in the English language. The result was that the English engineers obtained a portion of their plant from the German firm. In this instance the German firm were enabled to act promptly through having an office in the country, where the Italian newspapers would naturally be taken. It would be too much to expect manufacturers in England to keep themselves posted up in the contents of all foreign journals, but this is just the work a Central Bureau of Information might undertake, and through it opportunities of obtaining business which are now lost might be brought to the notice of subscribers."

Newspaper Science.—We have occasional specimens on this side of the Atlantic, and the New York *Herald* possesses a reporter who will one day make his mark. The article was entitled "Millions of Volts," and was intended to describe a large glass plate static machine. The reporter says: "It is expected, in short, that not only will be the spark be very long, but that it will be at least half an inch thick. If this becomes a fact, we can expect some remarkable performances with this machine." . . . . "The light of the future may be solved by means of the immense Leyden jars attached to it. The oscillatory discharge from a Leyden jar is ordinarily immense. From these jars it is enormous, and perhaps great enough to oscillate the surrounding atmosphere sufficiently to produce natural light waves." The article goes on to say that: "The earliest electrical machines were so constructed that absolute contact—that is friction of two bodies—was necessary in order to generate the electric current, and these may be designated as true frictional machines. The more modern machines which have replaced the old frictional machines are called influence machines, and act upon the principle of electrophones." . . . . "In fact, if enough amperage, as the scientists say, can be produced from this machine, which generates millions of volts, by multiplying the volts and the amperage together to produce a larger number of what are known as 'watts,' a single man turning the crank of a small motor doing likewise, will be able to light up every incandescent lamp in the city of New York."

Electricity in Indian Warfare.—The recent attack on the British camp on the Malakand (writes a correspondent of the *Standard*) has once more emphasised the necessity for such isolated military posts being furnished with an electric search-light. Had there been a search-light available on this occasion, its use might, perhaps, have averted an attack. It would certainly have minimised our casualties, and enabled the defenders of the position to give a better account of the enemy. The extended application of the use of electricity in our Indian warfare has already been urged in the *Pioneer*, and attention has been drawn to the fact that during the Chitral campaign the bursting of a few star shells led the tribesmen in the Panjkhora Valley to abandon their intention to rush a camp at night. The obvious advantages of a search-light as a means of defence for standing camps liable to hostile attack are such as to put all consideration of cost out of the question. There are no engineering difficulties involved that cannot be overcome by our electrical engineers, and to neglect the use of what is universally admitted to be a necessary appliance of modern warfare is to be behind the times. Another point that requires consideration is the prevention of sentries and outlying pickets being stalked in the darkness and murdered, as now frequently happens. Protection might be easily afforded by electrical means in various ways, and to disregard the many possible advantages of electricity which modern science has placed at our disposal is little less culpable than to fail to adopt the most modern rifle and ammunition.

The Platinum Output of Russia.—The mineral sources of Russia are doubtless imperfectly understood. Russia is so vast, and its people so far behind the times that much relating to what are doubtless its most important features are comparatively unknown. There is no doubt, however, that at the present time Russia is the greatest producer of platinum in the world. It is estimated that the output of platinum from Russian sources is nearly 50 times greater than that of the whole world. The Russians have certainly recognised the importance of the platinum industry, and in 15 years its output has been doubled. Nearly 6,000 kilogrammes of this rare metal is now placed upon the market per annum. Russia, however, confines its attention to merely mining the ore, which is found entirely in the Southern Ural district. Germany imports the ore, and makes it up into metal, so that what metal Russia requires she has to buy back again from Germany. There is an interesting article in a recent issue of the "Handels Museum," which is really a report by the Russian Ministry of Finance, on the production of platinum. Those who are largely interested in this metal should not fail to read it. Attention is called to the high price which has ruled during the last few years. Even at the present time raw platinum costs £45 per kilogramme. It used to be thought that platinum ore would be a prolific source of iridium, but the anticipations have not been justified, this rare metal being only found in small quantities. Last year only 4·1 kilogrammes were obtained. Evidently those who think that this metal is going to play a great part in the fatality of the future, will have to look elsewhere for a source of it.

Comforting for Gas Shareholders.—In spite of the increasing use of electricity, the consumption of gas advances by leaps and bounds. The Gas Light and Coke Company in 1887 sold 16,788,208,000 cubic feet; last year they sold 20,115,728,000, and for the first half of this year they have sold 10,543,386,000.

A Mistake.—The Brighton Electric Railway does not run on Sundays, so the station at the Aquarium end, it is said, is appropriated by psalm-singers, who decorate it with banners, on which texts, more or less suitable for the occasion, are inscribed. A correspondent says he read on one occasion:—"Seek ye the Lord while He may be found." Electric cars every five minutes.

Inflammable Hair-Wash.—Prof. Raphael Meldola writes to the *Times*:—"The only difference of opinion that has arisen in connection with the painful case which has given rise to this discussion is on the point whether the ignition was caused by an electric spark or by some unsuspected and possibly distant flame. It is, of course, well known to all those who are in the habit of dealing with low boiling-point liquids giving off inflammable vapours, such, for example, as ether, that the presence of a naked flame, even at a distance of many yards, is attended with great danger. But in the present case I can entirely corroborate by personal experience the contention of Lord Kelvin in your issue of August 2nd that an electric spark, although in itself feeble, is quite sufficient to ignite an explosive mixture of hydro-carbon vapour and air. Some years ago I was consulted by a manufacturer who had an extensive business in what is called the "dry cleaning" of wearing apparel. In this process the goods, previously well dried, are immersed in a vessel of benzine, in which they are kept in motion by means of mechanical stirrers. In spite of every precaution to insure the absence of naked flames in the building in which the operation was conducted, fires were constantly occurring, and at one time the process threatened to become a failure on account of this apparently spontaneous inflammability of the hydro-carbon vapour. It was only when the possibility of the generation of electricity and the passage of sparks was suggested that precautions were taken to exclude air from the upper portions of the vessels and that the process became practicable. Without going into technical details, I may point out that the experience afforded by this process points most conclusively to the correctness of the electric spark theory of the ignition, and on this ground alone the use of such inflammable hydro-carbons for cleaning the hair—apart from the very doubtful question of their efficacy—should be absolutely condemned.

Ader Recorder.—In our issue of July 30th, we said, in speaking of the Ader recorder:—"It seems surprising that no one has suggested the application of photographic means to dead-beat reflecting galvanometers," &c. We now understand that photography applied for recording mirror signals was suggested just 20 years ago by Mr. H. G. Cheeseman, and this method of photographing mirror signals has since then been patented several times.

"A Broken Reed."—We have recently called attention to the lamentable condition of the cable communication with South Africa. "Delayed in transmission," "traffic subject to serious delays," and similar advices issued to the public, are at times varied by the information that telegraph communication with South Africa is totally interrupted. On the 19th of last month the Cape Town to Nossamedes cable broke down, and was repaired nine days later, only to break down again on the 7th of this month for several days; thus, within less than a month, the West Coast route to the Cape has been interrupted for about a fortnight, a fact which might have been of small importance to the Government and to the public had the alternative line along the East Coast of Africa been in working order; but this line also broke down on the 27th of last month, a fortnight ago, and is still interrupted. Thus, during less than a month, we find that both routes to South Africa have been quite useless for about a fortnight each, and that during some four days of this period, the communication with South Africa generally, as well as with the Seychelles and Mauritius (not to mention Madagascar) has been totally interrupted. At present we are informed that "there is a serious delay in telegrams to and from South Africa." The numerous difficulties which have arisen during the last few years in connection with these lines merit the most serious attention, and we are glad to learn that the day is not far distant when an additional cable will be laid to the Cape, on the lines suggested by Sir Charles Mills many years ago. We may remark in connection with this improvement, that there is still room for a considerable reduction in the amount at present charged for telegrams to South Africa, and we hope that this question will not be neglected in the negotiations for the new line.

An 80-Mile Transmission Scheme.—The *American Electrician* records that the contract for the transmission of power from a river running through the Santa Ana Canyon to Los Angeles and Pasadena, Cal., a distance of 80 miles, has been concluded. The amount of power to be transmitted will be 4,000 H.P. to commence with. This transmission scheme will be the longest that has yet been undertaken.

The Demand for Copper.—The following figures taken from *Engineering* show the growth of the demand in metric tons for copper in the European countries during the past four years:—

	1893.	1894.	1895.	1896.
United Kingdom ...	93,615	90,069	91,984	115,537
Germany	60,513	62,955	70,349	85,371
France	33,886	31,837	40,323	49,007

The Liquefaction of Fluorine.—Some interesting experiments are described in the *Comptes Rendus* by H. Moisson and J. Dewar, which ultimately resulted in the liquefaction of fluorine. The gas itself was prepared by the electrolysis of fluoride of potassium in solution in anhydrous hydrofluoric acid. The gas then liberated was then cooled down, using liquid oxygen as the refrigerant. It was found that fluorine lost its chemical activity at 183° Centigrade, no longer attacking glass, and finally became liquid at 185°. The paper, which may be consulted in the *Comptes Rendus*, Vol. 124, No. 22, page 1202, may also be found done into English in the *Chemical News*, No. 1,959, Vol. 75, page 277.

NEW COMPANIES REGISTERED.

Improved Electro-Plating Company, Limited (53,519).—Registered July 28th with capital £20,000, in £1 shares, to adopt certain agreements, to acquire British Patents No. 20,354 of 1894, and No. 27,776 of 1896, and to carry on the business of electro-platers and general platers, electricians, engineers, &c. The subscribers are:—F. C. Evans, 225, Carlton Vale, Kilburn, surgeon, 500 shares; G. W. Lund, 12, Marlborough Hill, N., civil engineer, 500 shares; A. P. Haggard, Lieut.-Col., Bailey's Hotel, Kensington, 500 shares; R. Davy, 479, Commercial Road, E., stationer, 300 shares; D. Anderson, 29, Trefoil Road, Wandsworth, engineer, 300 shares; H. F. A. Thorsen, 95, Brixton Road, S.W., gentleman, 50 shares; G. Pearman, 11, Baker Road, Harlesden, gentleman, 50 shares. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first. Qualification £100; remuneration £150 each per annum (£200 for the chairman), and a share in the profits. Registered office, 7, Southampton Row, W.C.

Electrical Undertakings, Limited (53,542).—Registered July 29th, with capital £10,000 in £1 shares, to purchase, operate, manufacture under, sell, assign, issue licenses under, and deal with patents, patent rights, and trade marks covering electrical and mechanical devices. The subscribers (with one share each) are: A. C. C. Codd, 13, Cheyne Court, Chelsea, merchant; W. J. Crozier, La Paix, New Malden, Surrey, accountant; W. Digby, Raleigh, Bromley, Kent, merchant; E. Gregg, 87, Winchester Street, S.W., stenographer; A. E. Griesbach, 17, Gloucester Road, Kew, clerk; H. E. Hyde, 2, Estelle Road, Mansfield Road, N.W., clerk; A. Riding, 24, Denbigh Street, S.W., secretary. J. A. Barham is the first and sole director. Registered office, Trafalgar Buildings, Charing Cross, W.C.

Electrical Investment Trust, Limited (53,574).—Registered July 31st with capital £5,000 in £1 shares to adopt an agreement with the Cycle Electric Lamp Company, Limited, and to promote, form, establish any companies, corporations, associations, and undertakings. The subscribers (with one share each) are S. E. Stoneham, 37, Hilldrop Crescent, Camden Road, N.W., gentleman; A. G. Craig, The Fawns, Ermington, South Devon, gentleman; R. H

Brown, jun., Melbourne House, Southport, merchant; J. P. Price, 4 and 5, Warwick Court, Gray's Inn, W.C., solicitor; A. D. B. Marsh, Spring Green, Isleworth, clerk; W. R. Craig, 195, Algernon Road, Lewisham, chemist; W. D. Fordon, Holmefield, Darley Dale, Derbyshire, gentleman. The number of directors is not to be less than three nor more than six; the subscribers are to appoint the first. Qualification £100; remuneration as fixed by the company. Registered by A. W. Osmond, 5, Furnival's Inn, W.C.

Electric Extension Company, Limited (53,607).—Registered August 4th with capital £50,000, in £1 shares, to carry on the business of electricians, mechanical engineers, suppliers of electricity, and manufacturers of, and dealers in, all kinds of electrical apparatus. The subscribers (with one share each) are: J. Atherton, Singleton, Huyton, Lancs., manufacturer; J. B. Atherton, Manhattan, Rainhill, Lancs., manufacturer; F. J. Leslie, 15, Union Court, Liverpool, solicitor; C. O. Grindrod, 11, Knowsley Road, Rock Ferry, gentleman; A. E. Haptie, 5, Durham Road, Seaforth, Liverpool, cashier; F. W. Lintern, 104, Northbrook Street, Liverpool, clerk; A. Ruckley, 8, York Road, Seacombe, clerk. The number of directors is not to be less than two, nor more than seven; the subscribers are to appoint the first. Registered by T. T. Hull, 22, Chancery Lane, W.C.

Crystal Electric Lamp Company, Limited (53,651).—Registered August 6th with capital £10,000 in £1 shares, to adopt an agreement with a company of the same name, and to carry on the business of an electric light company, and of electricians, engineers, &c. The subscribers (with one share each) are:—E. J. Pringler, 42, Lytton Road, Leytonstone, clerk; J. M. Barton, 2, Felday Road, Lewisham, clerk; P. M. Evans, New Farm, Epping, gentleman; H. H. Rice, 10A, Idol Lane, E.C., clerk: E. F. Langdale, 19, St. Dunstan's Hill, E.C., merchant; E. A. Norrington, 13, Springfield Road, South Tottenham, clerk; J. H. Smeed, 105, Bouverie Road, Stoke Newington, gentleman. The number of directors is not to be less than two nor more than five; the first are F. W. French, H. Lovegrove, H. Jones, and R. Gibbs; qualification £500; remuneration as fixed by company. Registered by H. H. Cooke, 10A, Idol Lane, E.C.

"X" Ray Syndicate, Limited (53,661).—Registered August 6th, with capital £15,000 in £1 shares, to adopt a certain agreement and to carry on the business of electricians, electrical and mechanical engineers, machinists, surgical and mathematical instrument makers, &c. The subscribers (with one share each) are:—W. H. Howard, 2, Mansfield Road, Ilford, E., clerk; S. C. Heron, 5, Broad Street House, E.C., gentleman; A. A. Heron, 135, Victoria Street, S.W., gentleman; W. Brook, 2, Fen Court, Fenchurch Street, E.C., merchant: J. L. Smith, Broad Street House, E.C., clerk; R. F. Clarke, Broad Street House, E.C., solicitor; J. T. Griffin, Broad Street House, E.C., merchant. Tae number of directors is not to be less than two nor more than five; the subscribers are to appoint the first; remuneration, 1 per cent. of the net profits divisible. Registered office, Broad Street House, New Broad Street, E.C.

John Stephens & Son, Limited (53,671).—Registered August 7th with capital £40,000, in £10 shares, to acquire the business carried on by J. Stephens at Ashfield, Cornwall, as "John Stephens and Son," to adopt a certain agreement, and to carry on the business of hemp and wire rope manufacturers, wire drawers and galvanisers, manufacturers of steel rods, eleectric and telegraphic cables, &c. The subscribers (with one share each) are: J. Stephens, Ashfield, Falmouth, rope manufacturer; Mrs. E. Stephens, Ashfield, Falmouth; J. G. Stephens, Ashfield, Falmouth, rope manufacturer; Mrs. J. G. Stephens, Ashfield, Falmouth; Miss M. Stephens, Green Bank, Falmouth; F. J. Stephens, Ashfield, Falmouth, rope manufacturer; C. R. Stephens, Ashfield, Falmouth, rope manufacturer. The number of directors is not to be less than than three, nor more than five. The first are J. Stephens, Mrs. E. Stephens, and J. G. Stephens; qualification, £500; remuneration as the company may fix. Registered by C. H. Hodges, 12, New Court, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

South African Lighting Association, Limited (27,609).—This company's annual return was filed on June 9th, when the capital of £50,000 in £10 shares was fully taken up. £10 per share has been called on 4,100, and £5 per share on 900 shares, and £45,500 has been paid.

Syndicate of Electrical Engineers, Limited (30,531).—This company's annual return has just been filed. The capital is £10,000, in £5 shares (100 founders'). 1,007 ordinary and 100 founders' have been taken up, and the latter are considered as paid. £4 per share has been called on the ordinary, and £4,003 10s. has been paid, leaving £24 10s. in arrears.

J. H. Pickup & Co., Limited (34,051).—This company's annual return was filed on July first, when 3,850 shares were taken up out of a capital of £25,000 in £5 shares. 800 are considered as paid, and £13,150 has been paid on the rest.

Spanish Telephone Company, Limited (41,589).—This company's annual return has just been filed. The capital of £16,000, in £10 shares, has been taken up and considered as paid.

CITY NOTES.

The Cuba Submarine Telegraph Company, Limited,

The report of the directors for the half-year ending June 30th, 1897, to be presented at the fifty-second ordinary general meeting of shareholders, to be held on August 18th, 1897, states that the gross receipts amount to £25,623 14s. 7d., and the gross expenditure to £7,005 15s. 1d., leaving a sum of £18,617 19s. 6d., which, added to the balance brought from the last account, £3,099 9s. 6d., leaves £21,717 9s. at the credit of revenue account. The traffic receipts show a decrease of £10,854 19s. 11d., as compared with the corresponding period of last year, this falling off being chiefly due to the loss of the French Company's traffic referred to in last report. The sum of £9,000 has been added to the reserve fund, which now stands at £118,000. The dividend on the preference shares will absorb £3,000, and leave £9,717 9s., out of which the directors recommend the payment of a dividend on the ordinary shares at the rate of 8 per cent. per annum, free of income tax, the balance, £3,317 9s., being carried forward to the current half-year. The cables, with the exception of the Cienfuegos-Santiago, 1891 section, which, as mentioned in the previous report, broke down in December last, have continued in good working order during the half-year. Arrangements have been made for the repair of the above cable in the end of the year, but in view of its age it has also been considered advisable to extend the Cienfuegos-Manzanillo cable to Santiago, thus giving a triplicate means of telegraphic communication between Cienfuegos and Santiago, as was contemplated at the time the Cienfuegos-Manzanillo cable was laid. A contract has accordingly been entered into with Hooper's Telegraph and India-Rubber Works, Limited, for the manufacture, transport, and laying of the cable required for this extension, and for the hire of their vessel for the above repair. The director who retires from the board at this time is Mr. George Keith, who, being eligible, offers himself for re-election. Mr. John Gane, the auditor, also retires, and offers himself for re-election.

The Waterloo and City Railway.

The seventh half-yearly meeting of the shareholders of the Waterloo and City Railway Company was held yesterday week at Waterloo Station, Mr. Wyndham S. Portal (the chairman) presiding.

The directors, in their report, notified that everything in connection with the undertaking was progressing satisfactorily, and the engineers (Mr. W. R. Galbraith and Mr. A. B. W. Kennedy) appended the following remarks:—"The northern or up tunnel has now been completed throughout, including the station and siding tunnels at the Mansion House. The City Station tunnel for the south or down line of rails has still to be executed, but the shield is in position, and driving will be commenced this week, and by the date of the general meeting the work will be fairly in hand, and will, we expect, be finished by the middle of September. The first instalment of the permanent way materials has been delivered to the contractors, and road laying has been commenced. The inclined passage from the City Station to the subways of the Central London Railway is in progress. The platform wall of the up line City station is being built. The whole of the underpinning of the piers and buildings at the Waterloo Station has been safely completed, and no settlement whatever has occurred in the South-Western Company's station works or offices. The inclined roads and subways between the high and the low level stations at Waterloo are well advanced, and the platform walls of the latter have been built. The retaining walls around the site of the terminal sidings south of Aubyn Street are finished, and the excavation of the enclosed area is in hand. The engine house of the generating station has been carried up to roof level, so far as it stands upon land already acquired by the company. Possession of

the remainder of the land is expected in the course of the next 10 days. The manufacture of boilers, engines and dynamos, and other electrical work, was commenced early in the year, and has now far advanced, the first engine and dynamo being ready for testing. Arrangements have been made for the electrical contractors to follow on the permanent way at once with the conductor rails and cables. The cables themselves are finished, and ready for laying, and the work generally is well forward, both as to the machinery for the power house, and the remainder of the electrical equipment."

The Chairman, in moving the adoption of the report and accounts, said the number of shareholders was now 669, as compared with 600 in February and 586 in the corresponding period last year. So far as the progress of the works was concerned, he thought everything was in a very satisfactory condition. The capital expenditure was well within their Parliamentary powers. The estimated amount for the past half-year was £87,700, but the actual amount reached was only £80,079. The half-year closed with a credit balance of £71,394. The rate of expenditure would necessitate the calling up of a balance of £180,000, which would complete the total share capital of £540,000. That financial call would be made probably about the end of October, a fact of which each shareholder would receive due notice. It was interesting and satisfactory to observe, the chairman went on to say, that the directors had had before them no cases of calls in arrear, every shareholder having paid up each of the four calls. Such promptitude, he said, added very greatly to the financing of the undertaking. The report from the engineers showed how the works were proceeding, but he thought he might add, as a postscript, that the tunnelling had been completed, that the first instalment of the permanent way had been delivered, and that the roadway had been commenced in both the tunnels. The directors were in constant communication with the Central London Railway Company, upon whom they had to rely for their connections with the subway stations, and they hoped to hand over the railway to the London and South-Western Railway ready for traffic by the end of the year. The chairman concluded by speaking of the success which had attended the efforts of the engineers, through whose care no accident of any magnitude had occurred in connection with the works.

Lieut.-Col. the Hon. H. W. Campbell (the deputy-chairman) seconded the chairman's motion. It was put to the meeting and adopted unanimously. The proceedings then terminated.

Tramways Union Company, Limited.

An extraordinary general meeting of the shareholders was held on Tuesday at Winchester House.

Mr. George Richardson, who presided, explained that they had met to consider a resolution authorising the company to raise £150,000 by the issue of debentures, for the purpose of adapting and equipping their tramways at Madrid with electric traction. The board had experienced considerable difficulties in obtaining the necessary permission to make the proposed change from horses to electricity, and, as the shareholders were aware, the negotiations had been going on for about two years. A working concession for 60 years had now been granted to the company, so that he thought there was a probability of their making a very good thing out of the undertaking in the future. The directors had full confidence in recommending the shareholders to agree to the issue of the proposed debentures, which would bear interest at the rate of 5 per cent. per annum. He then moved the resolution.

Mr. Concanon seconded it, and it was unanimously agreed to.

The Liverpool Overhead Railway Company, Limited.

The ordinary half-yearly general meeting of the shareholders of the Liverpool Overhead Railway Company, Limited, was held on Tuesday, 10th inst., at the Law Assurance Rooms, Cook Street, Liverpool. Sir William Forwood, chairman of the company, presided.

The directors' report stated that the growth in traffic had been well maintained during the half-year, and the opening of the station at the Dingle had satisfied their expectations, and proved to be a convenience to the patrons of the line. The expenditure upon maintenance had been larger than usual, but it did not point to any permanent increase beyond what was necessary to provide for the extra mileage.

The Chairman, in moving the adoption of the report, said he was glad to able to present the shareholders with such a satisfactory statement of accounts. Comparing the past half-year with the similar half of last year, there had been an increase of 529,000 in the number of passengers carried. The exact figures were 3,739,575 for the half-year ended June 30th, 1896, and 4,269,260 for the past six months. First-class passengers showed an increase of nearly 153,000, which he thought was largely due to the opening of the Dingle Station. The revenue for the half-year was £36,025, being an increase of £4,700 as compared with the corresponding half of last year. The working expenses were £22,789, against £19,634; these having, of course, increased in consequence of the extended line to the Dingle. They had now an extra station, with the extra power required to work that station. The interest on mortgage debentures was £2,890, as against £2,500 in the same half of last year. With the addition of the balance brought forward of £3,064, there was left a profit available for dividend of £13,410, against £11,115 in the same half of 1896. The directors proposed, with the approval of the meeting, to pay a dividend of 5 per cent. per annum on the preference shares, and 3 per cent. per annum on the ordinary shares, against 2¾ per cent. on these shares last year. That would leave £3,800 to be carried forward to current account, against £2,800 in the same half of last year. It had always been the desire of the directors to keep the condition of the railway in a thoroughly sound state, and they had spent rather more during the past six months in maintenance and up-keep. For one thing, they had renewed a large number of the bonds by replacing the wrought-iron bonds by copper bonds, and by this means they had increased the efficiency of the line, and especially the lighting at the Dingle end. They were still effecting improvements, and hoped before the year was out to give a very steady and efficient light at that end. They had also spent rather more money in the up-keep of the rolling stock and permanent way, and £511 had been spent in compensation. They would remember the small accident at the Dingle. The directors thought it better to pay the compensation out of revenue than from the contingent fund, which they were gradually building up to meet such claims. The revenue derived per passenger during the past half-year was 1·99d., as against 1·96d. in the corresponding half of 1896. He was glad to say that had been increasing gradually, for in December, 1894, it was only 1·64d., which indicated that they were now carrying a larger number of first-class passengers. The expenditure as compared with revenue for the half-year had been 63·17 per cent., against 63·92 in the previous half-year ending December 30th, so that there was a slight reduction in proportion to the revenue. As compared with the corresponding half of 1896, however, there was a slight increase, the figures at that time being 63·05 per cent. The expenditure per train mile was 15·3d. in the half-year against 15·10d. in the same half of last year. There again there was a satisfactory reduction. The train mileage had gone up from 320,992 to 363,399 during the six months. Everything in regard to the structure of the railway, the electrical plant, coaches, &c., was kept up to the highest efficiency. The directors believed it was the truest economy to keep everything in the best possible order. They had given the tramway company six months' notice to terminate the agreement with them, and after the end of the year they would save the sum paid to that company. The shareholders would have observed that the Liverpool Corporation, in taking over the tramways, had decided to start the first experimental line of trams worked by electricity from the Dingle to Castle Street. In a sense, that would mean that these trams would run in opposition to the overhead railway, but the chairman of the Tramway Committee had stated that there was no wish to do anything antagonistic to the railway, and that the Dingle route was selected as being the most convenient for the experiments with the overhead trolley system. The shareholders of the railway company need not be alarmed, as he believed the railway would be able to maintain its traffic. They could increase their facilities and expedite the trains, and so serve the public that they would extend their patronage to the railway in preference to going by the trams. No institution for for the last half century had done more to serve the trade of the port than the overhead railway, and he hoped they would receive the most careful consideration at the hands of the Corporation.

Mr. Edward Lawrence seconded the motion, which was carried.

The Chairman, replying to a vote of thanks to the directors and the staff, paid a warm compliment to Mr. Cottrell, the engineer and manager, for his able and assiduous services on behalf of the company.

Bristol Tramways and Carriage Company, Limited.

The report of the directors of the Bristol Tramways and Carriage Company, Limited, for the half-year to June 30th, states that the gross receipts amounted to £59,704, and the general and working expenses and renewals to £45,839, leaving a net balance of £13,865, which it is proposed to distribute as follows:—Interest on 4 per cent. mortgage debenture stock, £1,815; dividend at the rate of 6 per cent. per annum for the half-year, £7,750; balance carried to reserve and renewal fund, &c., £4,300. The receipts from the tramways department showed an increase of £4,515, and from the carriage department, £837. The total number of passengers was 9,497,693. The extension of the electric tramways to Staple Hill is being proceeded with, and application has been made for an order to construct a light railway from St. George to Hanham to be worked by electricity.

Crompton & Company, Limited.

An extraordinary general meeting of this company was held on Monday at Cannon Street Hotel, when the resolution passed on the 22nd ult., for amending the articles of association, was confirmed.

Mr. J. Trotter, who presided, stated that the proposals of the directors for the reduction and rearrangement of the capital of the company would be submitted for the consideration of the shareholders after the holiday season.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending August 8th, 1897, were £939; week ending August 9th, 1896, £895; increase, £44; total receipts for half-year, 1897, £5,456; corresponding period, 1896, £5,419; increase, £37.

The Great Northern Telegraph Company. The receipts in July, 1897, were £22,400; January 1st to July 31st, 1897, £159,200; corresponding months, 1896, £163,600; corresponding months, 1895, £174,800.

The Liverpool Overhead Railway Company. The receipts for the week ending August 8th, 1897, amounted to £1,781; corresponding week last year, £1,700; increase, £81.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending August 6th, 1897, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,485.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1894.	1895.	1896.	Closing Quotation, Aug. 4th.	Closing Quotation, Aug. 11th.	Business done during week ended Aug. 11th, 1897. Highest.	Lowest
149,900£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	4 %	...	99 —103	99 —103	...	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	5 — 6	5 — 6	...	...
923,960£	Anglo-American Teleg., Ltd.	Stock	£2 2s.	£2 9s.	£2 13s.	54 — 57 xd	54 — 57	54½	...
3,038,020£	Do. do. 6 % Pref.	Stock	£4 4s.	£4 18s.	£5 6s.	100½—101½xd	101 — 102	101¾	101
3,038,920£	Do. do. Defd.	Stock	...	...	...	10¼— 10⅜	10¼— 10⅜	10⅜	10 7/16
130,000	Brazilian Submarine Teleg., Ltd.	10	7 %	7 %	...	15 — 15½	15 — 15½	15 3/16	...
75,000£	Do. do. 5 %, Debs., 2nd series, 1926	100	5 %	5 %	...	113 —117	113 —117	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	2½%	4 %	4 %	3¼— 3⅜	3¼— 3⅜	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	170 —175	170 —175	...	...
653,586£	Do. Do. Sterling 500 year 4% Deb. Stock Red.	Stock	...	...	...	106 —107	106 —107	106¾	106⅛
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	1½%	1½%	2 %	1/16— 3/16	1/16— 3/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	9 — 10	9 — 10	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	19 — 20	19 — 20	19⅞	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	4 %	3½— 4½	3½— 4½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	9½— 10½	9½ — 10½	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 5,000	50	4½%	4½%	4½%	103 —106 %	103 —106%	...	...
60,710	Direct United States Cable, Ltd.	20	2 %	2½%	2½%	9½ — 10	9½ — 10	9⅞	9⅜
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½%	6½%	6½%	16½— 16⅝xd	16⅝— 17¼	17 1/16	16⅜
70,000	Do. 6 % Cum. Pref.	10	6 %	6	6%	18 — 19 xd	18 — 19	18⅝	18 1/16
89,900£	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	5%	101 —104 xd	101 —104	...	...
1,302,615£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4%	128 —131	128 —131	...	...
250,000	Eastern Extension, Australasia and China Teleg., Ltd.	10	7 %	7 %	7⅛	17½ — 18	17½ — 18	18	17⅝
35,500£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5 %	5%	99 —103	99 —103	102½	...
133,100£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	5%	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	4%	128 —131 xd	128 —131	...	...
51,100£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	5%	99 —103	99 —103	100½	...
69,200£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	5%	100 —103	100 —103	100½	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4 %	4%	103 —105xd	103 —106	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4%	107 —110 %	107 —110%	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	4½%	4½%	4½%	11½— 12 xd	11½— 12	11⅝	11½
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6%	16⅝— 17¼xd	16⅝ — 17¼	17	16⅞
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅝%	10 %	10%	26 — 27	26½ — 27½	27½	...
160,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	5%	104 —107	104 —107	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10%	54 — 57	54 — 57	...	...
100,000£	London Platino-Brazilian Teleg., Ltd. 6 % Debs.	100	6 %	6 %	6%	107 —110	107 —110	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000	5	4 %	4 %	...	2 — 2½	2 — 2½	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5 %	5½%	5½%	6½ — 6⅝	6½ — 6⅝	6 11/16	6 9/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	16	15½
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	5 %	6 — 6½	6 — 6½	6¼	6 5/16
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	105 —110	105 —110	107¾	106½
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	4½%	5 %	5 %	⅝— ¾	⅝— ¾	...	..
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	4 %	107 —110	107 —110	...	...
11,839	Reuter's Ltd.	8	nil	5 %	5 %	7 — 8	7 — 8	7⅞	...
3,381	Submarine Cables Trust	Cert.	...	...	...	135 —140	135 —140	...	...
58,000	United River Plate Teleph., Ltd.	5	3 %	4 %	...	3½— 4	3½— 4	...	...
146,733£	Do. do. 5 % Debs.	Stock	5 %	5 %	...	100 —105	100 —105	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	nil	4 %	nil	5 — 6	5 — 6	...	...
213,400£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	102 —105	102 —105	...	...
64,256	Western and Brazilian Teleg., Ltd.	15	3 %	3 %	2 %	9 — 9½	9 — 9½	...	...
33,129	Do. do. do. 5 % Pref. Ord.	7½	5 %	5 %	5 %	6⅞— 7¼	6⅞— 7¼	...	...
33,129	Do. do. do. Def. Ord.	7½	1 %	1 %	...	2¼— 2⅝	2¼— 2⅝	2 7/16	...
382,230	Do. do. do. 4 % Deb. Stock Red.	Stock	...	...	...	101 —104	101 —104	103	102⅛
88,321	West India and Panama Teleg., Ltd.	10	⅛%	⅛%	1 %	⅞— 1⅛	⅞— 1⅛	...	..
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	10¼— 10⅝	10 — 10½	10⅝	10½
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	9 — 10	8½ — 9½	...	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,600	100	5 %	5 %	5 %	105 —108	105 —108	...	...
1,163,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds	$1000	7 %	7 %	7%	104 —108	104 —108	...	...
160,100£	Do. do. 5 % Ster. Bonds.	100	5 %	6 %	6%	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	4½%	5 %	6 %	12½— 13½	12½ — 13½	...	...
20,000	Do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	...	...
26,000	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277	5	5 %	5 %	5 %	9⅞ — 10¼	9⅞— 10¼	10 1/16	...
60,000	Do. do. do. 4½ % Deb. Stock Red.	Stock	...	4½%	4½%	110 —113	110 —113	...	...
40,000	City of London Elec. Lighting Co., Ltd., Ord. 40,001—80,000	10	5 %	5 %	7 %	23½ — 24½	23½— 24½	24⅛	23/16
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	16½ — 17½	16⅛— 17½	17½	16⅞
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	130 —135	130 —135	...	...
22,475	County of Lond. & Brush Prov. E. Ltg. Ltd., Ord. 1—22,475	10	...	nil	nil	12⅝— 13¼	12⅝— 13¼	13	12⅝
20,000	Do. do. do. 6% Pref., 40,001— 60,000	10	...	6 %	6 %	15 — 15½xd	15 — 15½	15⅝	15 5/16
10,000	House-to-House Elec. Light Supply, Ord., 101 to 10,100	5	...	...		8½— 9	8⅝— 9¼	8 13/16	8⅝
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000	10	3 %	4 %	5 %	16½ — 17½	16½ — 17⅛	17¼	17 1/16
12,500	Do. Ord., 50,001—62,500, iss. at £2 prem.	10	...	...	...	15½ — 16½	15½ — 16½	...	...
220,000	Do. 4½% first mortgage debenture stock	...	4½%	4½%	4½%	118 —122	118 —122	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	1 %	2 %	4 %	15 — 16	15 — 16	15 9/16	...
19,980	*St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	6¼%	7½%	10½%	16½— 17½xd	16½— 17¼	17¼	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	10 — 11 xd	10 — 11	...	...
50,000	Do. do. 4 % Deb. stock Red.	Stock	...	...	...	102 —105	102 —105	...	...
67,900	*Westminster Electric Supply Corp., Ord., 101 to 68,000	5	5 %	7 %	9 %	14½ — 15½xd	14½ — 15½	15½	14 13/16

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred share warrants, profits being used as capital.
§ Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1894.	1895.	1896.	Closing Quotation Aug. 4.	Closing Quotation, August 11th.	Business done during week ended Aug. 11th, 1897. Highest.	Lowest.
20,000	British Electric Traction	10	...	...	...	13 — 13½	13 — 13½	13⅜	...
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000...	8	2½%	...	...	⅞— 1⅛	⅞— 1⅛	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	3 %	...	...	1⅜— 1⅝	1¼— 1½	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock.... ...	Stock	4½%	...	...	105 —109	105 —109	106	105¼
76,770	Do. do. 4½% 2nd Deb. Stock Red. ...	Stock	...	...	...	93 — 97	93 — 97	...	...
19,126	Central London Railway, Ord. Shares	10	...	...	...	9⅜— 10¼	9⅜— 10¼	10⅛	...
143,105	Do. do. do. £6 paid	10	...	...	...	5⅝— 6¼	5⅝— 6¼	5 15/16	...
58,830	Do. do. Pref. half-shares £1 pd. ...	...	...	...	...	1¼— 1⅜	1¼— 1⅜	...	...
61,777	Do. do. Def. do. £5 pd. ...	...	...	...	...	4¼— 4⅜	4¼— 4⅜	...	...
630,000*l*	City and South London Railway	Stock	1 15/16%	1 15/16%	1 15/16%	64 — 6	65 — 67	67	66
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	*nil*	*nil*	...	1½— 2	1½— 2	...	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	5	5 %	5 %	...	2¼— 2⅜	2¼— 2⅜	...	...
17,139	Do. do. do. "A" Shares 01—017,139	5	5 %	5 %	...	4¼— 4⅜	4¼— 4⅜	...	...
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	5 %	5½%	1⅜— 2 xd	1⅜— 2	2	1⅞
16,343	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	7 %	7 %	7 %	2⅜— 3¼xd	2⅜— 3¼	2⅞	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	...	...	⅜— 1	⅜— 1	...	...
67,275	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	...	...	½— ¾	½— ¾	...	...
9,600*l*	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	*nil*	10½%	...	9 — 11	9 — 11	...	...
12,500	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	6 %	8 %	10 %	18½— 19½	18½— 19½	...	...
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	7 %	18½— 19½	18½— 19½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	4½%	4½%	108 —113	108 —113	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	10 %	10 %	10 %	20½— 21½	20½— 21½	21	20½
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	105 —108	105 —108	...	...
27,500	†Liverpool Overhead Railway, Ord.	10	1½%	2⅞%	2⅞%	12¼— 12⅜	12¼— 12¼	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	15½— 16	15½— 16	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	15 %	15 %	36 — 39	37 — 40	39	38½
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	102 —105	102 —105	...	...
54,000*l*	Waterloo and City Railway, Nos. 1 to 54,000, £8 paid ...	10	...	...	...	10⅜— 11⅛	10⅜— 11⅛	11 1/16	11

Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1893—0%; 1891—7%§ 1890—6%

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

* Birmingham Electric Supply Company, Ordinary of £5 (£4 paid), 7⅞, £5 (fully paid) 9½.

Electric Construction Corporation, 6 % Debentures, 103—106.

House-to-House Company, 7 % Preference, of £5, 10¼—10⅜xd.

Do. do. 4½% Debentures of £100, 109—111.

* From Birmingham Share List.

Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 13—13½; 1st Preference Cumulative 6 %, £5 (fully paid), 8¼—8⅜. Dividend, 1896, on Ordinary Shares 7 %.

London Electric Supply Corporation, £5 Ordinary, 1⅝—2.

Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 8—8½. Dividend for 1896—6 %.

Bank rate of discount, 2 per cent. (May 13th, 1897).

LOSS IN STOPPAGES OF ELECTRIC CARS.*

By Prof. HERMANN S. HERRING.

In answer to the query made in the last issue under this heading by "S. Mountain," concerning data of the relation between the amount of energy required to propel an electric car and the number of stops made during a trip, I would say that from a large number of tests I found that the difference between making a stop and start at a station and running past it, varies from 75 watt-hours to 100 watt-hours according to the grade and load, the average for ordinary conditions with a partially loaded 7½-ton car being 85 watt-hours per stop. These tests were made by running the car over a road on which definite stopping places were designated, and a different number of stops made on successive trips, each trip being repeated for the same conditions until the readings agreed. The car was loaded with sand bags and weighed on car scales. A Thomson portable recording wattmeter and a Boyer speed recorder were placed on the car, and records were kept of the watt-hours, time, stops and load for each half trip. The difference between the watt-hours required for a different number of stops enabled the watt-hours per stop to be determined.

These values being obtained from about 100 such tests are fair average results, but cannot be depended upon for any particular case, as conditions may cause a very large variation. But as an illustration of how these small values aggregate, the following figures may be interesting: Assuming the cost of electrical energy at 1 per cent. per kilowatt-hour, one stop would cost ·085 cent, nearly one-tenth of a cent. At this rate, the cost of making one extra or unnecessary stop on each trip for 15 trips daily would amount to 1·28 cents per car per day, and $4.67 per car per year; for 15 cars, $70 per year, and for 100 cars, $467 per year, merely for one extra stop per trip. This does not include the cost of brake-shoes and wear and tear, nor the capital invested in the increased size of the power house.

Taking an actual instance of engine house located where two lines of cars pass the door, 30 cars making 15 round trips a day and each car passing the engine house twice on each round trip, it was found that on this same basis it costs the railway company for electrical energy alone 76 cents per day, or $278 per year, to stop its cars at this one place. Even should the assumption of one cent per kilowatt-hour prove too high, yet the results are important.

The inquirer asks, "If an electric car, in travelling 5 miles (at an average speed of 10 miles per hour) makes 60 stops, and absorbs a definite amount of energy expressed in kilowatt-hours, how much less energy will be required to propel the same car, under the same conditions, the same distance, only making 30 stops?" In answer to this, I would say that for city running with the ordinary 7½-ton car, moderately loaded, 1·4 would be about the average number of kilowatt-hours required per car mile, when eight is the average number of stops per car mile, and 10 miles per hour the average speed, judging from a large number of tests. On this basis it would require 8·7 kilowatt-hours to run this electric car 5 miles at 10 miles per hour, and make 60 stops. Thirty stops less, at ·085 kilowatt-hours per stop is 2·55 kilowatt-hours, which subtracted from 8·7 leaves 6·15 kilowatt-hours required to make the trip with only 30 stops, a difference of 29 per cent. These calculations are only approximate, but are based upon good average figures.

About 74 per cent. of the total energy required for propulsion is expended for accelerating and lifting the car, and 26 per cent. for horizontal traction, which shows the importance of utilising as much as possible of the energy stored in the car in starting and in going up grade. Various methods

* *American Electrician.*

have been suggested of either storing the surplus energy in accumulators or else throwing it back into the line. There is no system in commercial form at present, but there doubtless will be soon, as the importance of the subject warrants serious attention. If a saving could be effected of one-half of the energy stored in an ordinary electric car under average city conditions, in being lifted and accelerated, it would amount to 763,000 foot-pounds per car mile, or an equivalent of 287 watt-hours. On the basis of 1 cent per kilowatt-hour, this would be ·287 cents per car mile, and for a 10-mile trip would be 2·87 cents; for 15 trips 43·1 cents per car per day, or $157 per car per year. For a 15-car road this would amount to $2,355 per year, and for a 100-car road $15,700, which, at a capitalisation of 5 per cent., would be equivalent to $47,100 and $314,000 respectively. Obviously the saving in power house machinery would also be very great.

In reference to the effect of careful handling of the controller, I would say that the difference between the kilowatt-hours per car mile required by two motormen is very marked. A number of experiments were made in order to obtain some data. A good average motorman was selected and instructed to run his car in the usual manner. The other motorman was instructed to run the car in the most careful manner, allowing it to "drift" as much as possible, and to use the brakes as little as possible. The same car was used in both instances, and was run on regular schedule time, making the same number of stops. The careful motorman used only 80 per cent. of the kilowatt-hours used by the "regular," although the latter was not careless, but rather above the average motorman. The difference of 20 per cent. in the kilowatt-hours used by these two motormen represents average conditions and not exceptional ones, but for the sake of avoiding possible exaggeration, and allowing that such expert motormen cannot be readily obtained, it would be perfectly safe to halve this figure, and take 10 per cent. as the amount of energy that can readily be saved by more careful handling of the controller, while on most roads the larger value, or at least 15 per cent., could be saved without doubt.

A few calculations based on a saving of 10 per cent. may be of interest, being the gain that would result by using less power on the line. Taking the average performance in city running on a 10-mile, 15-car, 15-trip road as 1,300 watt-hours per car-mile, a 10 per cent. saving amounts to 1·3 cents per trip, 19·5 cents per car per day, $71.20 per car per year, and $1,067 per year for the entire road, or for a company operating 100 cars, this amounts to over $7,000 per year. The figures may appear startling at first, but they are based upon data obtained from a large number of tests, and under the conditions of actual service, and are by no means extreme or unusal values; they can be taken as very fair values, and err in being too small rather than too large. They show the importance of properly training the motormen and inspectors, as the ordinary motormen of to-day undoubtedly use more energy than is necessary.

The difference between two ordinary motormen making the same trip under similar conditions is from 3 to 8 per cent. Motormen can very frequently be seen keeping the current on until just about to stop, and then jamming down the brakes to stop the car in its length, thus utterly wasting the kinetic energy. When running down grade they keep the current on much longer than necessary to give the car the necessary start, and often throw the controller on before releasing the brakes and put the brakes on before shutting off the current. These cases, though small in themselves, amount to formidable quantities in the aggregate, because they occur almost continually. It is very important, however, to make use of the momentum and allow the car to "drift" as much as possible. In this way the greatest saving can be effected. The following calculations may be of interest in showing the magnitude of the energy possessed by a moving car:—

An ordinary single-truck street car weighing, with passengers, 17,200 lbs. (8·6 tons), and having a traction coefficient of 12 lbs. per ton, would require a horizontal draw-bar pull of 103 lbs. on the level. At a speed of 10 miles per hour the kinetic energy would be 57,500 foot-pounds, which would enable the car to drift 560 feet theoretically, and probably 300 feet actually. In city work, especially, a mere acceleration up to a speed that will carry the car by drifting to the next stop is usually all that is necessary. The experiments made show that the schedule can be adhered to within 1 or 2 per cent. with such careful running.

The following calculation shows the energy stored in a car in going up a grade:—Using the car mentioned above and going up a 3 per cent. grade for 500 feet, the potential energy stored in the car would be 258,000 foot-pounds. In going down the same grade, the force exerted on the car, which is the component of the weight along the grade, would be 516 lbs. Subtracting the friction, that is, the draw-bar pull on the level, 103 lbs., leaves 413 lbs. not required, which either produces acceleration or is wasted in the brakes. The energy required to propel the car down this grade is the friction, 103 lbs. times 500 feet, or 51,500 feet-lbs., which subtracted from 258,000, the potential energy at the top of the grade, leaves 206,500, which is a surplus and is stored as kinetic energy in the car in reaching the foot of the grade, if no brakes are used. The velocity of the car at the foot of the grade would be 27·8 miles per hour, and with a friction of 103 lbs. the car would go about 2,000 feet on a level after reaching the bottom of the grade, due to its own momentum, assuming the friction to be constant. Actually, this would be much less, due to the wind resistance and the increased friction at higher speeds, &c., but even at 50 per cent., that is 1,000 feet, the distance would be three times the length of the up-grade, or 1,500 feet, from the top of the grade to a point where the car would stop. This shows the great amount of energy stored in the car in going up-grade, which is mostly wasted by the brakes in slowing up and stopping on down-grades. Although it is impossible in many cases to run under these ideal conditions, it is nevertheless important to bear this question in mind, and avoid the use of brakes as much as possible.

In brief, therefore, the following should be every motorman's maxim:—*Use the brakes as little as possible, and drift as much as possible.* Care in this direction will result in a large saving of energy at the station, and care in starting cars will also result in a saving that is well worth considering.

Further data concerning this subject can be found in an article entitled, "Electric Car Tests," which appeared in the *Electric Railway Gazette*, August 31st to November 23rd, 1895. Reprints of the latter will be gladly sent by the author to anyone specially interested in data concerning the operation of electric cars.

SINGLE-PHASE MOTORS.

The *American Electrician* for June, 1897, contains an article by Mr. Berg on single-phase motors, the chief feature of which is a test of a 100 H.P. single-phase induction motor constructed by the General Electric Company, and now in operation in the Narragansett Electric Lighting Company's power station in Providence, R.I.

The motor is mechanically coupled to a continuous current generator. It has twelve poles and runs at 600 revolutions per minute, and is wound for 2,000 volts, being supplied directly from the mains.

The starting device used with this motor consists of a reactive coil placed in series with a non-inductive resistance connected across the mains. A wire taken from the junction of the inductive and non-inductive resistances is connected to one terminal of the induction motor, and the other two terminals are connected directly to the mains. When the motor has attained the speed corresponding to synchronism with the supply current the starting device is cut out.

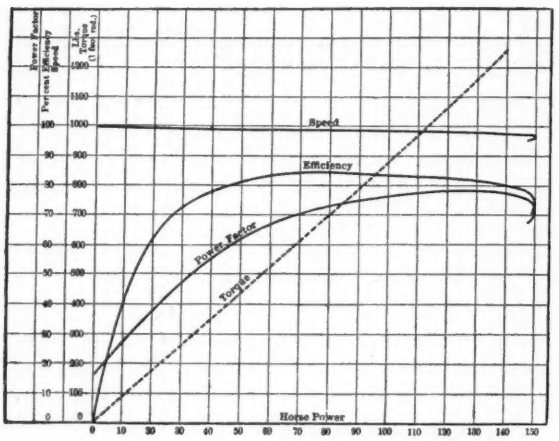
The following table gives results of a test on the above mentioned monophase motor:—

Load.	Efficiency.	Power factor.
At ¼ load	68 per cent.	0·43
„ ½ „	81 „ „	0·62
„ ¾ „	84·5 „ „	0·72
At full load	82 „ „	0·76
At 25 per cent. overload	82 „ „	0·78

These results are represented graphically in the accompanying figure.

The figure also contains curves of torque and speed.

The most noticeable feature is the constancy of speed at all loads. Between no-load and full load the curve only shows a drop of speed of 1·5 per cent.



There does not appear to be anything striking either as regards efficiency or power factor. For so large a motor one might reasonably have expected both of these quantities to have reached higher values.

It is stated that the starting current is only 30 to 50 per cent. more per pound of torque than when running. From this, however, we can learn but little because the starting torque may be small—perhaps too small to start without mechanical aid under load.

BURSTING OF A FLY-WHEEL IN THE TACOMA RAILWAY COMPANY'S POWER HOUSE.*

By A. M'L. HAWKS, C.E.

At 1 p.m. on Sunday, July 11th, an accident occurred to an engine in the power house of the Tacoma Railway Company, resulting in the bursting of the big fly-wheel, and the practically total destruction of the engine of which it was a part.

The initial source of the trouble was the breaking of one of the small brass arms on the governor which holds up the sliding collar. This disabled the governor, and thus the regulation of steam to the engine was destroyed, which immediately set the engine to racing. The engineer in charge of the power house ran at once to cut off the valve, and attempted to shut off the steam by means of the hand-wheel. When he had closed this valve about half way, finding that he had not only not reduced the speed of the engine, but that it was constantly gaining, and also being terrified by the whipping of the belt (which connected the fly-wheel with the driving pulley on the line of shafting, and beneath which he had to stand to manipulate the hand-wheel), which had become considerably frayed, owing to the extreme tension put upon it by the racing engine, he abandoned his task and sought safety in flight. The manager of the company and the secretary were in the office adjoining the engine room. Hearing the noise, they hastened to the engine room to attempt to aid the engineer in his task of controlling the engine. But, seeing the peril of their position so near the wild engine, they also fled from the building. As they emerged, a report like the sound of a cannon came from the engine room. The walls immediately in front of the engine were burst outward; the roof, together with some cross arms, wires, &c., was thrown into the air, and steam, brick, iron and lime dust covered the immediate region of the engine.

The fly-wheel of the engine, which was a segmental pulley, weighing 40 tons, 25 feet in diameter, 4 feet 8 inches across the face, the rim having a thickness of 2½ inches, reinforced with two ribs, 1 inch by 6, was found to have exploded into over twenty pieces. One piece, weighing about 100 lbs., was thrown a distance of over 400 feet. Several pieces, weighing from 150 to 500 lbs., were thrown more than 250 feet. Several pieces of 500 lbs. weight or over were thrown directly upward through the joists and double flooring of the ceiling overhead, and the rafters and double thickness of roofing, and returning through the same coverings, landed in the power house within 10 feet of the original fly-wheel. The lower portion of the wheel seems to have flown tangentially forward, striking against the masonry surface of the wheel pit, and considerably battering the same. A few stray pieces flying through the power house destroyed the driving pulley on the line of driven shafting, and injured the dynamos to a small extent. On the hub of the fly-wheel there was not left a piece of any arm longer than a foot in length; the engine shaft was torn from its bearings; one of the teeth on the clutch on the engine shaft, engaging with a smaller engine in an adjoining room, was torn out; the piston rod of the racing engine was bent near the crank pin to an angle of 30°; the connecting rods to the valves were bent and twisted beyond recognition, and, practically, nothing but the steam chest remains in place.

Fortunately for the smaller engine, which was engaged on the main shaft with the one destroyed, and which for a time acted as a balance, keeping down the speed of the racing engine, one of the bolts holding down the pillow block bearing near the clutch gave way, which, in turn, brought a strain on the clutch, breaking out the tooth, and in this way it became disengaged, and no further harm was done.

One of the curious phenomena of this explosion was the way in which the pieces travelled. Some pieces came directly through the front of the building, rising at an angle of 30 to 45°; another part rose vertically through the roof, and a third portion flew almost horizontally forward in the wheel pit. Probably not more than 90° were covered by the flying missiles. The strain upon the rim of this wheel must have been very great, as, in one instance, a piece of about 2 feet of the circumference of the wheel by 4 feet 8 inches wide, coming from between the arms, not pierced by bolt holes and showing no signs of flaw, was torn out and thrown aside by itself. This piece, with its reinforcements, shows on its two faces of fracture over 300 square inches of good, clear grained cast-iron. Taking the tensile strength of cast-iron at 30,000 lbs. per square inch, it will be seen that it must have required an energy of several million pounds to effect this destruction.

The exploded engine was one built by the Frick Engine Company, of Pennsylvania, and was rated by the builders at 750 horse-power with 80 lbs. of steam, but had been run at times under a load of 850 to 900 horse-power. At the time of the accident it was running under a little more than normal load, due to the Sunday excursion business of suburban lines.

This accident will point out the necessity of a means of regulating such machinery, not only by the governor and the hand wheel cut-off valve, but also by some means whereby, from a safe distance from the danger of flying pieces of the engine or fraying belts, the supply of steam can be easily regulated.

* *Scientific American.*

EXHAUST STEAM HEATING.

As an example of what can be effected in the utilisation of exhaust steam, the *Street Railway Review* states that the Danville Electric Light and Power Company have 2,000 feet of street mains of from 6 inches to 12 inches diameter covering the principal business street and serving 15 business blocks, including the Government building, court house, and one hotel. The system was in use last winter with satisfaction. During the day two engines of 125 H.P. are at work, and at night more steam is produced than can be used because of the light engines. About a million and a half or two million cubic feet of space are thus heated. The Holly system is described as one of the best, and it is said that where the day and night loads are of fair proportions, the sale of the exhaust steam will pay fuel charges, water rents, and boiler room expenses. Boilers producing 100 H.P. will heat a million feet of space and bring in from $3,000 to $5,000 annually. The exhaust can be let off at about 5 lbs. above atmosphere, and as the system grows there is no need to stop at using waste steam. It will pay to sell direct steam as done by the New York Steam Heating Company.

In the Holly system the mains are laid inside bored out logs of pinewood, the shell remaining being 4 inches thick and thickly coated with asphaltum. They are laid over a line of tile drains for the sake of dryness. The wooden jacket serves both to protect and to conserve heat. Expansion diaphragm boxes are placed at intervals in the pipe, the diaphragm being a disc of corrugated copper secured to the body of one end of pipe, and nipped between the flanges of a circular disc box which is attached to the opposing pipe end, so obviating stuffing boxes. In addition to Danville the system is in use by the electrical railways of Springfield, St. Joseph, Terre Haute, and many others, and it is evidently well calculated to promote economy. Given a sufficient demand for exhaust steam in heating, and half the anxiety of an electric station disappears. Economical engines would cease to be needed; their place would be taken by plainer and cheaper machines.

Our contemporary does not say if the demand for heat is maintained the year round. In America, over a great part of the country, there is so great a need for heating of buildings in winter that we should think the demand would be far from even. In this country where winters are so usually mild, we do not fit ourselves out for being warmed in the way they do in America, but it is certain there is a field for steam heating. Indeed, at the time of writing this, the weather is so inclement that though in August and the ordinary fire is not lighted, the opportunity of turning on steam heat would be welcome. One street railway is cited as having cleared last winter £3,000 over and above all the extra expense incurred in producing the steam furnished. Yet the cost of the mains and all accessories was but £6,000, so that here there was a return of 50 per cent. The efficiency of the steam engine is so limited by natural laws that of the heat of the steam very little appears as power, and almost all the heat goes off in the exhaust. Condensing is an economy, but with an outlet for the exhaust it would be a sheer waste to condense.

We have often felt surprised that in some of the manufacturing towns of the north with steam power all over the area, some system of steam heating has not been adopted. The mill workers daily round begins with getting up much too early simply to light a fire to boil a kettle, and this silly process goes on in each of a hun-

dred contiguous houses. As regards the use of electricity and the general convenience and comfort of life, London is absolutely asleep. If we take it that an average small suburban house could be lighted for one horse-power, and allow 6 lbs. of coal per H.P. hour, then the exhaust steam from that weight of fuel ought to be ample for heating purposes, for a daily average of 60 lbs. of fuel will be used in such a house in ordinary circumstances, and most of the heat goes up the chimneys. In a street of 200 houses burning gas and fuel at an average of £15 annually there should be available £3,000 as gross income. The fuel cost of the light need not be above £1,200 with coal at even 20s. No doubt £1,000 would cover it and leave £2,000 for interest and wages on a plant of 200 horse-power. With wages amounting to £500, and interest to another £500, both liberal allowances, there is left £1,000 annual saving. But this is not all. In each of those 200 houses the provision of electric light and steam heat would at once place the inhabitants free of any need for help from Abigail or Mary Ann, and the further economy would be such that once started upon there would be no end to such little schemes. But the mass of the people have not the intelligence to see this. Large central stations may be more economical to work as regards mere light-giving, but the small station just big enough for one engineer and stoker, with assistant for second shift, and also stoker, would be very well suited to the supply of one or two streets of houses. Light could be paid for by meter, and heat by a rate levied on the cubical contents of a house, or possibly by a fan meter. There ought to be no difficulty in getting up such a scheme, charging rent of wiring and for radiators in such cases where tenants could not afford the outlay. But the majority of people are shiftless, helpless mortals, and the prospect of any such socialistic idea is, we fear, impossible. People who call themselves socialists are, perhaps, the furthest from any capacity to practise the science.

Obviously a scheme for 200 houses would embody a central station at the middle of a street about 1,200 yards long. It would require one engine of about 50 I.H.P. to run, say 20 hours daily, delivering steam to the mains and accumulating electricity for the night and for domestic power purposes. The engine would be very plain and not liable to break down, but there would be a spare engine and spare boiler. In many localities an artesian well could well be combined in the scheme with great economy, for water can be pumped for less than one penny per 1,000, and domestic supply costs up to 3s. and 4s. per 1,000 gallons. People, generally, have no idea of the economy that could be secured by a common action of the kind thus sketched out.

THE POST OFFICE INQUIRY.

The Postmaster-General has made the following statement in reference to the recent inquiry:—

"The Postmaster-General, in concert with Mr. Hanbury, has carefully considered the representations which have been made to him by various members of Parliament during the last few days, as well as the statements of members of the staff whom he saw, on the same occasions, at the request of these members.

"The subjects which have thus been brought before Mr. Hanbury and himself have been very numerous, and are of very unequal importance. The examination of the whole of them must necessarily occupy a great deal of time; and if it were attempted to deal with minor, local, and departmental matters, would make it impossible to arrive at a decision on the more important questions involved until after the Recess. They therefore consider that it will be more convenient and more satisfactory to the staff to reserve their decision on the minor matters brought before them, and to deal at once with the larger issues submitted to them, and especially with the larger issues involving the position and prospects of great bodies of men such as the telegraphists, the countermen and telegraphists, and the sorters in London, the sorting clerks and telegraphists in the provinces, and the postmen both in London and the provinces.

"The Tweedmouth Committee, after a prolonged inquiry, recorded the opinion that the maximum salary of £160 a year 'affords an adequate remuneration for the work entrusted to a sorter, a telegraphist, or a counterman and telegraphist' in London; and similarly, that the maximum salaries accorded to sorting clerks and telegraphists in the provinces afford 'adequate remuneration for the work.' With these opinions the Postmaster-General and Mr. Hanbury, after full investigation, desire to record their concurrence.

"Though, however, they are in this respect in accord with the Tweedmouth Committee, there are other points, some of which were not dealt with by the Committee, which seemed to them to require consideration, and which they have decided to deal with in the following way.

"1. The statements which have been laid before them, and which are supported by the inquiries which they have themselves made, have convinced them that some of the class of senior telegraphists are employed almost throughout the year on purely supervising duties, and this fact, coupled with the necessity which at present exists for increasing the operating staff, has impressed them with the necessity of an addition to the supervising staff. They are prepared, in consequence, to recommend the creation of some 40 additional assistant superintendents in the Central Telegraph Office, and the promotion to these places of qualified senior telegraphists. They do not propose, however, to accompany the creation of these places with any corresponding reduction in the senior class, as they have satisfied themselves that duties of a superior quality can be found for the existing number of senior telegraphists. The effect of this arrangement, therefore, will be to afford promotion to 40 qualified senior telegraphists to the position of assistant superintendent and of 40 qualified telegraphists to the position of senior telegraphist. The Postmaster-General will take an early opportunity of inquiring whether any similar rectification of the numbers of the supervising classes may be justifiable in consequence of the growth of the work in the provincial offices.

"2. The rule, which was introduced in 1894, that every telegraphist promoted to the post of senior telegraphist, every counterman and telegraphist appointed to the post of senior counterman and telegraphist, in London, and every telegraphist appointed to a clerkship in the provinces, should pass a technical examination, has much to recommend it; but the Postmaster-General and Mr. Hanbury are struck with the consideration that it may in certain cases operate to bar the advancement of an officer who, though in other respects a skilled operator and efficient servant of the Department—may not possess the requisite technical knowledge required for an examination on purely technical subjects. They have, therefore, decided to abolish this rule, and, in promoting to vacancies in future, to rely solely on the careful selection of the best qualified officers.

"3. The technical examination, however, required of an officer promoted to an assistant superintendent's place will be retained.

"4. The above recommendations apply to telegraphists, and countermen and telegraphists alone. But the Postmaster-General and Mr. Hanbury's attention had also been directed to the recommendation of the Tweedmouth Committee, that a double increment should be granted on his attaining the age of 24 years,

"(*a*) To any sorter, sorting clerk, or telegraphist who should pass a qualifying examination in both sorting and telegraphy, and who should be ready to place his services as they might be required at the disposal of the authorities on either side.

"(*b*) To any telegraphist who should pass an examination in technical telegraphy.

"While agreeing in principle with these recommendations, they have decided to substitute for the condition that the officers shall be 24 years of age, a provision that the officers shall have completed five years' service, and shall be not less than 21 years of age.

"As, moreover, they have ascertained that some time may elapse before a telegraphist presenting himself for the technical examination may receive the requisite certificate, they are prepared, when a telegraphist so presents himself and passes the examination without any delay of his own creating, to date the additional increment from the date on which the examination is held instead of from the day on which the result of the examination is notified.

"6. Some officers both on the postal and telegraph side appear to be under the apprehension that the introduction of an efficiency bar at a certain stage in an officer's career has introduced a new obstacle in his progress to the maximum of his class. The Postmaster-General desires, therefore, distinctly to state that it is not intended by the introduction of this bar to check the progress of any efficient officer. But that, just as under the old system, no officer could properly be promoted who was not capable of performing the highest duties of his class, so under the new system no officer's progress will be checked whose character and efficiency would have entitled him to promotion under the old system. While under the old system, however, the officer would have waited for advancement till the occurrence of vacancies on the class above him, under the new system the advancement of an officer of efficiency and good conduct to the maximum of his class will be continuous, and will not depend on the occurrence of vacancies. The acquisition of a dual qualification or of a certificate of technical knowledge in telegraphy will not be regarded as necessary for the efficiency of an officer for the purpose of this paragraph.

"7. It was the obvious intention of the Tweedmouth Committee that the rights of existing holders of allowances, emoluments, and other privileges should be maintained. The Postmaster-General and Mr. Hanbury are not satisfied whether, in carrying out the recommendations of the Committee, injustice may not unintentionally have been done to some officers—*e.g.*, they are not sure whether all the sorters in the Circulation Office have received a fair equivalent for the loss which they may have experienced in the reduction of the rates of Sunday pay. The subject is a very complicated one, and requires very careful examination. But they wish at once to state that it shall not be lost sight of, and that, if their investigation should show that hardship has, in any case, been inflicted inadvertently on any member of the staff, they will have pleasure in redressing it.

"8. The Postmaster-General and Mr. Hanbury have also considered the very voluminous statements laid before them on behalf of the postmen. They think it right to state that, specially having regard to the concessions which, since the Report of the Tweedmouth Committee, have been made on the subject of Christmas-boxes, they concur in the general conclusions of the Committee as to the sufficiency of postmen's pay. But there are other subjects connected with the position of postmen which they have considered with much care. They desire, for instance, to give favourable consideration to any claim which a rural postman may make, under the recommendation of the Report, for suitable accommodation at the end of his walk. They have also been impressed with the claims of auxiliaries doing somewhat less than five hours' work, who receive none of the privileges of sick pay, holidays, &c., enjoyed by those actually doing five hours' work. Some of these men, however, already receive the actual pay of men doing five hours' work, and, while it would not be reasonable to treat them in all respects as entitled to the same privileges as men working for somewhat longer hours, they are of opinion that the men so paid should receive an annual holiday of nine days, one-half pay during absence on sick leave, and a boot allowance of 10s. a year.

"9. They have also considered the complaints which have been made that certain portions of the staff only receive their holidays in the winter months. They recognise the hardship of this state of things, but, at the same time, they think that the staff hardly

appreciate the difficulty of remedying it in a service (like that of the telegraphs) where the business is, roughly speaking, 30 per cent. greater in the summer than in the winter months. It is their hope, as it was the hope of the Tweedmouth Committee, that the staff, by qualifying themselves to work on both sides of the service, may not only secure for themselves an appreciable rise in their incomes, but may also facilitate the ultimate settlement of the question. But, in the meanwhile, the Postmaster-General and Mr. Hanbury will carefully consider whether, without injustice to the claims of senior officers who may at present be in enjoyment of the better months, it may be possible to devise some system of rotation by which the whole staff in turn may have a holiday in the better months of the year.

"10. The Postmaster-General and Mr. Hanbury cannot conclude this memorandum without reminding the staff that no branch of the public service has ever received ampler opportunities for stating and re-stating their case than have been accorded to the staff of the Post Office. The time has now arrived for accepting the decisions of those who are responsible for them. And, though they cannot hope that their decisions can meet all the expectations which the staff may have formed, they feel that they are entitled to trust to the loyalty and good sense of the staff to accept the finding on their case at which they have arrived, after approaching it with every desire to do full justice to the servants of a great department."

The dispute from the clerks' point of view is set forth on another page.

COWPER-COLES'S PROCESS FOR ELECTRO-ZINCING STEEL WIRES.

Both pickling and hot galvanising have the disadvantage of reducing the strength of wires, and of distorting and rendering brittle iron and steel of small section. By exposure to the lowest temperature of the galvanising bath (which averages some 1,000° F., the fusing point of zinc being 775° F.), steel wire of high breaking strain has its hardness, and consequently its ultimate tensile strength and elongational efficiency, reduced by the drawing of the temper and formation of an iron zinc alloy on the surface of the iron by as much as from 5 per cent. to 10 per cent. It is the practice, when coating steel wire, to keep the bath of molten zinc at as low a temperature as possible, and to run the wire through at a high rate of speed. Both these causes lead to a considerable waste of zinc by reason of the rapid solidification of the metal on the comparatively cold wire, and consequently the ready breaking or cracking off of the covering metal on bending or twisting, owing to the difficulty with which molten zinc of low temperature adheres to the steel, except after prolonged contact. In some cases the wire, on leaving the bath, is wiped between asbestos rubbers, but steel thus treated is found to resist corrosion only for a short period. Many attempts have been made to electro zinc wire, but it has not been found practicable, until recently, to produce a wire capable of withstanding more than one immersion in a copper sulphate solution. Most manufacturers have ceased to galvanise the best classes of steel wire, which cost some £35 per ton, on account of the great risk there is of rendering it worthless, which is clearly a disadvantage as the advisability of protecting the steel is unquestionable, as corrosion is found to be very marked on the inner strands of wire rope. Electro-zincing does not reduce the tensile strength or elasticity of steel wire, even in wires having a tensile strength of 170 tons or more per square inch, such as are used in the manufacture of pianos. The zinc coating put on by the hot process is also uneven, and the increased weight is often a matter for consideration; the thickness can only be varied within narrow limits, the minimum weight of zinc being about 1½ oz. per square foot, maximum 3 ozs., except when the molten zinc can be raised many degrees above the most

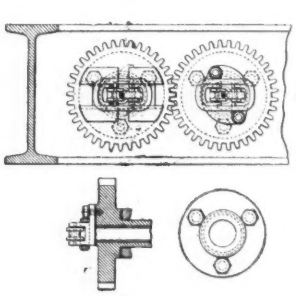


Fig. 1.

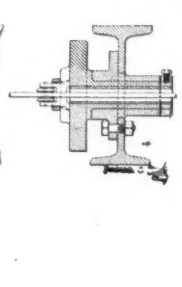


Fig. 2.

economical working temperature, and the articles removed gradually from the bath so as to give the zinc time to drain off before getting chilled, or in the case of thin sheets and wires, which are capable of having some of the zinc squeezed off by rollers or other suitable mechanical means. Wires can be coated with zinc by the Cowper-Coles process to a thickness of $\frac{3}{1000}$ths of an inch, or an increased diameter of $\frac{6}{1000}$ths of an inch, capable of withstanding eight immersions in a saturated solution of copper sulphate. A wire $\frac{62}{1000}$ths of an inch in diameter, with a total thickness $\frac{3}{1000}$ths of zinc applied by the electro process, will withstand repeated bending round a bar 1 inch in diameter, without exhibiting any signs of peeling or cracking.

The plant for the Cowper-Cowles process consists of a long vat, which is constructed of wood, and divided into compartments lined with sheet lead, which forms the anode. Wood covers faced with lead are placed over the compartments, and are provided with counterweights, so that they can be readily lifted for the purpose of cleaning the vat, or inspecting the wires under treatment. The covers, when in position, form part of the anode, making electrical contact with the sides of the compartments, and thus form a circular anode around each wire. Contact brushes provided with weights or springs press upon the wires in spaces provided between the covers, and convey the current back to the dynamo. The solution is circulated rapidly through the plating vat, and passed into tanks supplied with zinc dust, where it is revivified. Figs. 1 and 2 show a form of burnisher suitable for brightening the deposits.

The coated wire is caused to pass through the agate rollers, which are mounted on carriers, and are capable of turning on centres. The carriers are arranged to move in guides, so as to respond to any unevenness or alteration of position of the wires, the guides carrying the rollers are pressed together by bands or springs to give the necessary pressure for burnishing.

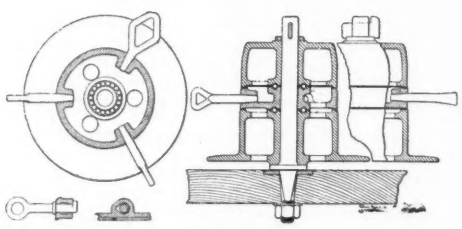


Fig. 3.

Fig. 3 illustrates a swift arranged to carry two coils of wire, so as to economise space and the first cost of the plant. Each swift is provided with two drums mounted so as to turn upon a spindle, the lower drum having a flange for supporting the lower coil of wire, there being between the drums and secured to the spindle a collar carrying pins or supports for carrying the upper coil of wire. The pins or supports are made so that they can be easily removed, or turned out of the way when desired. When the coil on the lower drum becomes exhausted of wire, by removing the pins or supports a coil from the upper, if un-exhausted, can be allowed to descend on to the lower drum, after which the pins or supports can be again inserted in the collar, and a fresh coil or coils can be placed on the upper drum.

THE EARTH, A GREAT MAGNET.*

By Dr. J. A. Fleming, M.A., F.R.S.,
Professor of Electrical Engineering in University College, London.

When the invitation came to me to address this evening a lecture to a Liverpool audience in accordance with a usual custom during meetings of the British Association, the natural desire arose to select some subject which should have a more or less close relation to the industries and commerce of your great city. With a choice somewhat limited by the nature of my own studies, it seemed to me, however, that we might find an appropriate topic in discussing, for a brief hour, the fact of the earth's magnetic properties, and the history of the discoveries by which that supremely important knowledge has been gained.

To do this with advantage, we shall approach the subject through the avenue of some experimental demonstrations intended to place you in possession of the elementary principles of magnetic science.

I hold in my hand a specimen of a kind of iron ore, the scientific name for which is *magnetite*, but which familiarly is called *lodestone*. This particular sample came from a place called Magnet Cove, in Arkansas, in the United States; but it is very widely diffused over many regions of the earth. This brownish stone would hardly attract your attention at all if you saw it lying in the road, but it has been known for many centuries to possess unique powers, and these can very easily be rendered evident to you.

First of all, let us dip the lodestone into a little heap of iron screws or nails, and note the fact that at one or more points on its surface it possesses the power to attract these objects. It will not pick up pins made of brass wire, but a bundle of sewing needles yields easily to its blandishments, and one large lodestone will readily lift up another smaller one, when the attractive portion or end of the first is brought near to the second.

If the lodestone is dipped in iron filings, these cling to all the edges and points of it, and the marvellous stone immediately grows

* A lecture delivered to the working men of Liverpool, September 19th, 1896, and published in the June issue of *Terrestrial Magnetism*

a beard, as it were, fringed all round with closely clustering particles of iron.

John Baptista Porta noticed that fact in 1589, but he hardly carried knowledge further than it had been taken in the well-known Latin poem of Lucretius, written 16 centuries before; and it is only in the writings of Nicholas Cabæus of Ferrara, in 1629 A.D., that we meet with a diagram which clearly records the observed facts that these filings cling, not uniformly all over the stone, but at certain predominant places, which afterward became called the poles. The attractive powers of this stone are not, however, its most remarkable property.

It is impossible definitely to assign a date to the first knowledge that if an elongated piece of lodestone is freely suspended horizontally, either by floating it on water in a bowl or by a thread tied round it, it places itself in a definite position, to which it returns if disturbed. The oldest picture of this experiment represents the lodestone placed, as one writer says, "like a sailor in a boat," and floated upon the surface of water in a larger vessel. The moment we repeat this experiment we can ascertain two facts—one, that there is such a directive tendency in a suspended stone; and next, that the two ends of the stone have different properties, and act differently to the same end of a second fixed lodestone.

Whatever Asiatic peoples or early nomad tribes may, in the dawn of history, have discovered concerning this directive power of the lodestone, or its "verticity," as Gilbert afterwards called it, there is no trustworthy evidence that the natives of Europe had any acquaintance with it before the twelfth century of our era. The earliest actual mention of it in English was in the writings of Alexander Neckam in 1200 A.D. In 1269 we find a very important contribution made to accurate knowledge of facts, as compared with useless scholastic speculations, in the celebrated letter of Peter Peregrinus, or Peter the Pilgrim (not to be confounded with Peter the Hermit), who was a soldier-monk serving in the army of Charles of Anjou, the brother of Louis IX. of France. This letter, indited on August 12th, 1269, in the trenches at the siege of Lucera, contains the clearest statement of the law of behaviour of magnet poles to each other.

Peregrinus describes in this letter the construction of a true magnetic compass as we have it at the present day, and he was perfectly familiar with the power of the lodestone to communicate its properties to an iron or steel needle. He knew that on stroking a steel needle over the lodestone pole, a communication of its attractive and directive powers will be made. This fact formed the starting-point for new investigations, and Peregrinus added another of immense value in its influence on magnetic theory; viz., that we cannot separate the poles of a lodestone one from the other.

The experiment with the floating lodestone compelled Peregrinus to definitely name the poles of the magnet. He says: "The stone so placed will turn in its little vessel until the north pole of the stone will stand in the direction of the north pole of the heavens, and the south pole of the stone in that of the south pole of the heavens, and if it be removed from this position, it will return thereto by the will of God."*

Peregrinus thus initiated that nomenclature which has endured to the present day, and the custom of calling the end of the suspended lodestone which directs itself to the north, the north pole, and to the south, the south pole.

He then went on to demonstrate that it is impossible to separate the north pole from the south pole, and that if a lodestone is broken in half, each half immediately possesses two opposite and perfect poles. We can try that experiment very much more easily with a fragment of magnetised steel, and the logical issue of this is to lead us to conclude that every particle of the lodestone or of the steel magnet is a complete lodestone or magnet.

At this stage it is necessary that your attention should be drawn to the difference in magnetic properties between iron and steel, a difference first noticed by Porta. Both iron which is chemically pure, and iron alloyed with carbon in the form called steel, can be magnetised; in fact, iron is susceptible of a higher degree or intensity of magnetisation than many kinds of steel; but the steel retains it more firmly than the iron against mechanical shocks, such as twisting, hammering, or bending. I show you the feeble power of iron to retain acquired magnetic polarity by magnetising this iron wire, and then giving it a little twist. That twist is sufficient to deprive it of all sensible magnetism. In magnetic language, pure iron is called "soft iron." There are certain kinds of steel called magnet steel which have a special composition, aiding them in acquiring strong magnetisation, and in retaining it when acquired.

So much, then, being said for the properties of the lodestone in itself, let us review a few of the facts connected with the conveyance of its powers to soft iron. Far back into classical times it had been known that iron brought in contact with the lodestone acquired the same powers while in touch with it. Early Phrygian iron miners settled in Samothrace were acquainted with the fact that the lodestone could lift up an iron ring, and this in turn could lift up another, and so on, the iron acquiring temporarily magnetic powers.

Magnetic quacks must evidently have flourished in these early days, since these Samothracian rings of iron were even prescribed as a remedy for gout in the fingers, and priests of Samothrace, in 514 B.C., appear to have driven a trade in magnetic cure-all rings, just as certain individuals at the present day do in magnetic belts.

It was found that a lodestone could be improved in lifting quality by furnishing its ends with iron caps, and these caps were called the armour or armature of the lodestone, a term which has survived to the present day in connection with dynamo machines. It was Peregrinus who probably first stated that a fragment of iron wire held near a lodestone becomes itself magnetised by induction, as it is called, and then places itself in a certain direction or position in space. It remained, however, for that ingenious philosopher, Descartes, whose grim physiognomy hardly suggests the extreme nimbleness of his intellect to grasp the idea that the lodestone affects all the space around it and along certain definite lines.

Nearly 100 years before that time, Gilbert had called the region round about the magnet, within which its influence is felt, its "orb of virtue," and represented little fragments of iron as setting in certain positions near a spherical lodestone.

Slowly, however, the idea grew up, not finally perfected until the time of Faraday, that the effect of the lodestone on iron and magnets not in contact with it could only be explained by the conception of a magnetic force distributed along curved lines in the space around the lodestone.

Descartes gives a most curious and correct diagram of what he considered to be the direction of these lines of magnetic force proceeding from a lodestone ball. Before turning to consider the epoch-making work of Gilbert, let us briefly examine the facts connected with the magnetic force of a magnet.

If one magnet, movable round its centre, is placed in the neighbourhood of another, we have already seen that there is a direction-imposing influence acting on the movable magnet. If we carry a small fragment of magnetised steel round a larger fixed magnet, we find at all points of its journey that the small magnet takes a particular direction with respect to the larger one, and this indicates the direction of the magnetic force at that place.

If, instead of this, we scatter steel filings over a magnet, each little fragment is magnetised by induction, and sets itself in a certain direction under the influence of the magnetic force. The whole collection of filings delineates certain curved lines, called lines of magnetic induction. I particularly wish you to see the nature of the field of force, as it is called, round a sphere having a magnet placed in it, and to note that a small magnet carried round the space always places itself so as to be in the same direction as these lines of magnetic force.

You must therefore think of a magnet, whether lodestone or steel magnet, as surrounded by this "orb of virtue," to use Gilbert's phrase, or, in Faraday's language, by its magnetic field, consisting of the curved lines of magnetic force. And more, you must think of these lines of force as closed loops, so that they must be pictured as coming out of one pole of the magnet, passing through the circumjacent space, and entering it again at the other pole, and so completing their circuit, partly inside and partly outside the magnet.

Before continuing to examine the historical progress of magnetic knowledge, it will be convenient to conclude the description of the work of Peter Peregrinus, by a mention of the inventions he made in perfecting the magnetic compass. The use of a floating lodestone, or steel needle magnetised by touching against a lodestone, to determine a constant direction for the purpose of navigation or travel, lies far back in antiquity.

During the Middle Ages the territory about the Baltic Sea was occupied by the races of Finns, the Esthonians, and the Lapps. The Finns were a gloomy, earnest people, showing on their faces marks of their Tartar connection, and relation to the far-distant Chinese. They were the earliest iron-workers in the north of Europe, and Finnish swords anciently had a reputation almost equal to that of the famous blades of Toledo. In the Baltic lies the island of Gottland, and in the twelfth century it had, as one of its principal cities, Wisbuy, a place of meeting for the vessels of all trading nations. Such influence had this place in controlling matters connected with navigation, that the ordinances and laws of Wisbuy formed an almost universal code of marine law, evidences of which are imbedded in our modern codes. In the middle ages it was a great centre of trade and point of contact for all maritime nations. It has been urged by some writers that it was from this great seafaring centre that, at the beginning of the 12th century, a general knowledge spread over Europe of the use of the lodestone in navigation. A great step, however, separates the use of a magnet merely for the purpose of ascertaining the north and south direction, and the method of obtaining by it the correct "bearing" of any object or direction of the ship's head.

Whatever may have been done before, Peregrinus, at any rate, brought inventive power to bear on the subject. He added a pair of sights and a graduated scale to the floating lodestone, and he improved the compass made with a pivoted steel needle by the addition of an azimuth bar and scale, so that it could be used to obtain the angular distance of any object from the meridian line. He thus invented the means by which, not a merely north and south direction, but the direction of a ship's head, could be ascertained exactly, as we do at the present day. There were, however, two well-known features of the modern compass card which the instrument of Peregrinus lacked. Those were the card divided into 32 "points," each having its appropriate name, to repeat which in order is called "boxing the compass," and the fixing of this card to the needle so that the card and needle turn together, the bearing of the ship's head being ascertained from the position of the card with reference to a fixed point on the case.

It was probably the Italian Gioja who first added the card, and we learn from a commentator of Dante, writing in 1380, that at that date the card, bearing the well-known star-like device called the "Rose of the Winds," painted on a circular card fixed to and turning with the needle, had already been invented.

Hence we may say for certain that at the end of the fourteenth century the magnet compass, as we have it now, was in general use, although time has added many improvements, and, latest of all, Lord Kelvin has given to us probably the most perfect form yet made.

The word *compass* is an old English word, signifying a circle. "My green bed embroidered with a compass" is mentioned in the will of Edward, Duke of York, who died in 1415.

* Park Benjamin. "The Intellectual Rise of Electricity," p. 172. The reader will find in this treatise a most careful historical survey of magnetic discovery, and to it the present writer has been indebted for many of the above and following historical facts.

The well-known instrument for describing a circle is called a compass or pair of compasses. To encompass means to surround as by a circle, and most of you at some time or another have seen a public house with the sign of the "Goat and the Compasses," which antiquarians tell us is only a corruption of the old pious house-motto, "God encompasses us." Hence the magnetic instrument takes its familiar name from the circle of degrees or points which Peregrinus or Gioja added to enable it to indicate the angular distance of an object from the meridian.

So far I have said nothing about the theories which had been formed as to the cause of the directive properties of the magnet. Those who came before Peregrinus had a general notion that the pole star governed the motion of the magnet. He knew that the pole star varies in position, and expressly states that the needle points, not to the pole star, but to the poles of the heavens. But whether attributing the orientation of the magnet to the pole star, or the celestial poles, or to the magnetic mountains in the northern regions, no one had yet solved the secret of the directive power until Dr. Gilbert turned his mind to the subject, and did not leave it until he had set the whole science of magnetism on a solid basis of experiment and scientific inference therefrom.

William Gilbert, born at Colchester in 1540, was the author of that great treatise, "On the Magnet," which has given him imperishable fame. Though a scholar, physician, and courtier, attached to Queen Elizabeth's household as body physician, and finally President of the Royal College of Physicians, we know of him comparatively little, except in the record of that scientific work which has come down to us from him in the pages of two books printed 300 years ago. But the contribution which he made to the subject was remarkable, and it was nothing less than the new idea that the whole earth itself is a great magnet, and the magnetic forces which act on all little magnets on its surface emanate from the globe itself. To understand the manner in which Gilbert approached the subject, we must realise that his great contemporary, Galileo, in Italy, was then marching forward in the triumphant career of discovery which followed his invention of the astronomical telescope, and that the minds of all intelligent men in that day were keenly interested in the contest raised by the enunciation of the doctrine of Copernicus, that the earth was not at rest in the centre of the universe, but revolves round the sun with a double motion —one of rotation round the sun, and of rotation round its own axis. Proof was being eagerly sought to support or disprove this new theory.

The great obstacle to the reception of this doctrine, apart from theological dogmas, was the difficulty of understanding how the earth was sustained in its orbit and its rotation maintained. Gilbert entered the lists with some ideas that the earth possessed magnetic properties, and was sustained and moved by the magnetic power of other celestial bodies. Like many other investigators, he was led by a wrong theory to new facts. He began by making a little model of the earth out of a lodestone, which he called an earthkin, or terrella, and with this he experimented. He poised upon the surface of his little globe small iron needles or little magnets, and noted that wherever placed the little needles pointed to the poles of this miniature earth. Regarding intently this fact that poised magnetised needles set themselves to point in the direction of the poles of the real earth, and that his little needles on their earthkin cut of lodestone did the same, he was led to make the grand induction that our globe itself acts as one great lodestone or magnet, and his idea was that the mineral we call lodestone is but, as it were, a fragment of the true mother earth, and, like a "chip of the old block," has all the properties in miniature which its great original possesses in the mass.

(To be continued.)

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1897.

[*Compiled expressly for this journal by* W. P. Thompson & Co., *Electrical Patent Agents, 322, High Holborn, London, W.C., to whom all inquiries should be addressed.*]

17,521. "Improvements in the regulating devices of horizontal shunt arc lamps." J. Wetter. Elektrizitats Actiengesellschaft vormals Schuckert & Co., Germany.) Dated July 26th. (*Complete.*)

17,523. "An improvement in or relating to coin-freed electrical meters." F. J. Beaumont. Dated July 26th.

17,527. "Improvements in electrical gas lighting devices." Hermann Ahrendt. Dated July 26th.

17,528. "Improvements in spring jacks for telephone switchboards." J. E. Kingsbury. (Western Electric Company, United States.) Dated July 26th.

17,540. "Improvements relating to electric light fittings." H. Lea. Dated July 26th.

17,545. "An improved electric circuit closing device." C. A. Holstein. Dated July 26th.

17,579. "Improvements in secondary batteries." A. W. Southey. Dated July 27th.

17,583. "Electric condenser." C. S. Bradley. Dated July 27th. (*Complete.*)

17,585. "Improvements in and connected with lighting by means of electricity." O. P. Macfarlane. (Richard J. Crowley, France). Dated July 27th.

17,596. "Improvements in trolleys or sliding contacts with electric cars." W. L. Wise. (Alvaro Silas Krotz, W. P. Allen and O. S. Kelly, United States.) Dated July 27th. (*Complete.*)

17,597. "Improvements in electric railways." W. L. Wise. (Alvaro Silas Krotz, W. P. Allen, and Oliver Smith Kelly. United States.) Dated July 27th. (*Complete.*)

17,601. "Improvements in apparatus for transmitting electric impulses." H. Godsal. Dated July 27th.

17,606. "Improvements in means for rectifying alternating electric currents." The British Thomson-Houston Co., Ltd. (E. Thomson, United States.) Dated July 27th. (*Complete.*)

17,630. "Improvements in the working of tramways and railways by overhead electric conductors." W. E. Kenway. Dated July 27th.

17,660. "An improved form of a variable electrical resistance with mercury contact." J. Ward. Dated July 28th.

17,676. "Improvements in electricity meters." W. Emmott. Dated July 28th.

17,683. "Improved means and apparatus for electrolytically decomposing salts of the alkaline and earthy metals for the manufacture of caustic bleaching powder, chlorine, and other products contained in them." F. H. Bowman and F. E. Bowman. Dated July 28th.

17,691. "Improvements in electric conduits." H. L. Doulton and C. E. Morris. Dated July 28th. (*Complete.*)

17,694. "Improvements in and connected with electric lamps for cycles and other vehicles and a device for attaching and adjusting same." J. Moores and H. O. Farrell. Dated July 28th.

17,695. "Improvements in and connected with armature cores of permanent magnet dynamo-electric machines." J. Moores and H. O. Farrell. Dated July 28th.

17,792. "Improvements in rail bonds for electric tramways." A. Whalley. Dated July 29th.

17,812. "Improvements in electric railway systems." J. M. Murphy. Dated July 29th.

17,820. "Improvements in the manufacture of electric cables and in apparatus therefor." W. S. Smith. Dated July 29th.

17,824. "Improvements in electric alarms for cars." A. Nathan. Dated July 29th. (*Complete.*)

17,826. "Improvements in electric lanterns." O. C Prasse. Dated July 29th. (*Complete.*)

17,837. "Improvements in apparatus for the electro-deposition of metals" J. Holloway. Dated July 29th.

17,924. "An improvement in field magnets for electric generators and motors." C. Tuson. Dated July 30th. (*Complete.*)

17,970. "A method of propelling boats or barges by means of electricity." J. R. Wigham. Dated July 31st.

17,998. "Improved means for exhausting incandescent lamps, vacuum tubes and the like." R. Burn. Dated July 31st.

18,029. "An improved process for the manufacture of electrode plates for storage batteries." C. Marschner. Dated July 31st.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Copies of any of these Specifications may be obtained of* Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., *price, post free,* 8½*d. (in stamps).*]

1896.

1,069. "Improvements in or connected with electrical condensers." C. Pollak. Dated January 15th. Relates to an electrical condenser consisting of an electrolytic cell wherein the electrical current, as it passes through it, under the influence of an alkaline or neutral solution, covers that which for the time being is the the positive electrode, with a coating capable of offering a high degree of resistance to the current; the effects of it being a polarization or charge (as the case may be) the power of which corresponds to the tension of the charging current; such coating offering no resistance to an opposite current, although it does not disappear under its influence. 2 claims.

2,248. "Improvements in electrical cut-outs." Hugo Hirst. dated January 31st, 1896. A cut-out is constructed with a dividing bridge of an insulating and non-inflammable substance, this division is provided with a hole through which the fuse is led in a zigzag course in such a manner as to interpose between the fuse terminals the isolating division and thus break down or prevent the formation of an arc between the terminals when the fuse is melted by an excess of current. 4 claims.

2,944. "Improvements in telegraphic and other electro-magnetic instruments." H. W. Sullivan. Dated February 10th, 1896. Relates to electro-magnetic instruments of the moving coil type, and consists of means whereby the magnetic resistance is greatly reduced with a corresponding increase of sensibility. The improvement is accomplished by so shaping the poles or pole pieces of the magnet, so as to bring them into exceedingly close proximity to each other without preventing free play of the coils. 6 claims.

5,563. "Improvements in magnetic compasses for night marching and course indicating." J. H. Steward. Dated March 12th, 1896. To the base of a magnetic compass for military use is provided a movable indicator capable of being clamped in position by means of a special clamping device. The indicator can be used with conjunction with a luminous line on the lid of the compass case, or the indicator can be provided with a sharp point so that the position can be accurately determined in the dark by feeling only. 3 claims.